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Participation in Pediatric Primary Care Innovation, DULCE, Increases Caregiver Agency and Resilience and Decreases Impact of Stress

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Abstract
The purpose of the present study was to explore outcomes and heterogeneous effects of an evidence-based, cross-sector pediatric healthcare intervention for families with infants, Developmental Understanding and Legal Collaboration for Everyone (DULCE). DULCE is tailored to allow families' needs and desires to drive DULCE intensity. This is a longitudinal study following families involved with pediatric primary care clinics from infant's birth to 15 months. Multi-level longitudinal modeling was used to compare the program's influence on resilience, parent agency, and the impact of stress on parent functioning among program recipients ($n = 172$) and non-recipients ($n = 170$). Study participants were recruited from four health care clinics in California and Florida, and participants completed in-person survey interviews at baseline (infant age 0–6 months) and final (infant age 12–15 months) timepoints, with a minimum of 6 months between baseline and final interview required. Assignment of families to intervention (participated in DULCE) or comparison group (received clinic care as usual) varied by clinic. The cross-sector pediatric primary care intervention screened families at high rates (70–90%), along with referring and connecting families to resources. DULCE participation was associated with increases in parents' agency and resilience. DULCE's positive influence on parent agency and impact of stress was observed with low dosage, and higher-risk families saw additional improvements in resilience at high dosage (high and low risk defined with Latent Profile Analysis). Findings reinforce the importance of examining heterogeneous effects of evidence-based interventions. DULCE's influence on parent agency and impact of stress was observed with low dosage; strengthened resilience among higher-risk families was found at high dosage. These findings document the value of a universal approach to prevention services in pediatric settings with tailoring that allows families to drive their engagement with the intervention.

Keywords Health-related social needs · Pediatric primary care intervention · Caregiver well-being · DULCE

Introduction

Background

Understanding the Nuances of Pediatric Interventions

Fifty years of research demonstrate that interventions to support families with young children can make a difference in a multitude of family and child outcomes. High-quality, comprehensive pediatric interventions can help families overcome early adversity (Dubowitz et al., 2022; Leslie et al., 2022). Modest overall effect sizes suggest that programs achieve stronger impacts for some families compared to others, but research to date provides few insights into why certain individuals benefit or what alternative interventions might be effective for those who do not (Asarnow et al., 2017; Olds et al., 2013). This has led to burgeoning interest among prevention researchers, policymakers, and practitioners in research that goes beyond average effect sizes to understand more precisely "what works for whom and how" (August & Gewirtz, 2019). Expanding our understanding in this way can inform a new generation of precision-based, personalized prevention interventions.

This study aims to explore the caregiver outcomes and heterogeneous effects of a universal, preventive intervention for families with infants, called Developmental Understanding and Legal Collaboration for Everyone (DULCE). A prior

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randomized controlled trial and subsequent expansion study of DULCE found positive impacts on infants' healthcare and families' access to concrete supports and behavioral health resources (Arbour et al., 2021, 2023; Sege et al., 2015). The current study takes our understanding of this intervention's success a step further by investigating outcomes that lend insight into *how* the intervention likely works and *for whom*.

Intervention

DULCE is a universal, evidence-based, cross-sector approach for families with infants from birth through 6 months of age, delivered through pediatric primary care clinics. Its primary goals are to use the broad reach of pediatric primary care to reinforce families' protective factors and systematically identify and address health-related social needs by improving on-time well-child visits and rates of screening and connecting families to resources (e.g., food pantries, childcare subsidies, counseling, support groups; Arbour et al., 2022).

DULCE embeds a community health worker ("Family Specialist", FS) within a cross-sector team that includes an early childhood system representative, legal partner, clinic administrator, and pediatric and behavioral health clinicians. FS receive Brazelton Touchpoint training (Brazelton & Sparrow, 2003). They use a strengths-based, relational approach and engage in family-led problem-solving during and in between the infant's well-child visits (WCV). WCVs are routine pediatric check-ups that are scheduled frequently during an infant's first year of life. FS are the families' most frequent point of contact: they attend each of the five recommended WCVs with the family and provide ongoing support between visits. The cross-sector team conducts weekly case reviews to support the FS, to collaborate and ensure families' access to benefits, services, and legal protections, and to identify opportunities to affect policy and systems improvements.

DULCE uses a flexible, family-centered tailoring approach. This means that every family should receive a minimum of five FS contacts, but beyond that, each family's' DULCE experience is unique and dictated by the needs identified and desires expressed by the family. This results in FS contacts of varying number and length based on families' needs and the setting of contacts (i.e., phone vs in pediatric clinic). In a recent study of DULCE, families had an average of 11 FS encounters and 280 min of FS contact time (Arbour et al., 2021). FS conduct systematic screening for seven health-related social needs (HRSNs) and provide multiple opportunities for families to disclose needs to the same, trusted individual (the FS). HRSNs are needs related to families' social well-being that impact health outcomes, including housing and food insecurity, unemployment, and domestic violence. Families might access behavioral health support and legal information through other members of the DULCE team; they might use DULCE navigational support to enroll in other early childhood programs or services. DULCE's dosage is driven by families' needs and desires, which are solicited through a combination of formal, systematic screening for HRSNs and ongoing dialogue and relational care.

Prior research demonstrated that DULCE improved on-time well-child visits and immunizations, two important healthcare outcomes that reflect quality and impact the cost of care delivery. Additionally, DULCE accelerated families' access to concrete supports and behavioral health resources (Arbour et al., 2021, 2023; Sege et al., 2015).

Research Questions

The hypothesized mechanism through which those changes occur is that DULCE's focus on relational care and cross-sector engagement fortifies families' protective factors in ways that enable families to engage in care and navigate care systems more effectively. The DULCE approach is built on the Strengthening Families framework, which recognizes that early infancy is a time of joy and vulnerability. Not only are infants sensitive to adverse and protective experiences during this period of rapid brain development (Shonkoff & Garner, 2012), but also caregivers often experience stress in the context of the physiologic, financial, and social impacts of caring for a newborn.

The Strengthening Families framework describes five protective factors: social connection, knowledge of parenting and child development, concrete supports in times of need, social and emotional competence of children (including parents' satisfaction in the parental role and ability to foster strong and secure parent–child relationships), and parental resilience (Harper Browne, 2016). By design and as demonstrated by prior research, DULCE directly bolsters the first three protective factors via relational care of the DULCE Family Specialist and team (Sege et al., 2014, 2015). This study further explores *how* DULCE strengthens families and *for whom* by first examining the association of DULCE with caregiver outcomes of agency, resilience, and stress in the whole sample. Analyses then examine how these associations vary by prior experiences of risks and strengths, as defined in a prior Latent Profile Analysis (Byers et al., 2022), and DULCE dosage. The research questions are below:

RQ1. Is DULCE participation associated with positive changes in caregiver agency, stress, and resilience?

RQ2. Does DULCE's flexible, family-centered tailoring approach result in families with greater needs receiving more intensive DULCE supports?

RQ3. Do the associations of DULCE with caregiver agency, stress, and resilience vary by families' previous experiences with risks and strengths and DULCE dosage?

Agency, Stress, and Resilience

In social science, agency is often defined as an individual's ability to self-determine their actions and decisions and competently access the resources they need (Hewson, 2010). Agency is an important construct, particularly for caregivers of young children, because it reflects self-efficacy, mastery, and a sense of control over one's life (Shanahan et al., 2003). A strong sense of agency is linked with greater likelihood of persevering in the face of stress (Hitlin & Kirkpatrick Johnson, 2015) and is associated with improved well-being (Welzel & Inglehart, 2010). DULCE's focus on increasing families' access to resources and empowering them as partners in their child's healthcare has the potential to improve caregiver's sense of agency, strengthening their ability to respond to stress with a sense of control.

Stress impacts caregivers and infants in numerous, often negative ways. The effects of significant and consistent, or toxic, stress on caregivers and young children are well-documented (Shonkoff & Garner, 2012). Stress can impact many aspects of an individual's mental and physical functioning (Joseph & Golden, 2016). The Family Stress Model describes the mechanisms through which stress has a negative impact on parents' psychological well-being, and consequently parenting and children's outcomes (Iruka et al., 2012; Masarik & Conger, 2017). Moreover, a child's first year of life can be a particularly challenging and stressful time for parents. DULCE is designed to provide relational, family-driven care that successfully connects families with young children to resources, ideally relieving some stress. Consequently, it is important to understand how DULCE influences experiences of caregiver stress, and how this effect may differ by families' prior experiences of risk and protective factors.

Resilience was originally defined through individual psychological theory as a trait characterized by successful adaptation in the face of risk or adversity (Egeland et al., 1993; Rutter, 1985). Important components to individual resilience include having a mastery perspective of stress and change, engaging the support of others, optimism, and being able to recognize and exert control and choice (Connor & Davidson, 2003; Rutter, 1985). Qualities of resilience have been shown to buffer the relationship between adversity and a number of socioemotional outcomes including depression, alcohol and tobacco use, and mothers' bonding with their infant (Bosma et al., 2019; Cicchetti, 2013; Kornfield et al., 2021; Meng et al., 2018). Resilience in families has been associated with better outcomes for children with mental health and attention disorders (Uddin et al., 2020). This supports the intergenerational connectedness of parents' coping capabilities and that of their children's experiences of adversity and health. Given this breadth of evidence pointing to the value of strengthening individual resilience, resilience is an important outcome to examine in relation to DULCE participation.

In addition to exploring possible caregiver outcomes through which DULCE works by testing associations between DULCE participation and outcomes of caregiver agency, stress, and resilience (*the how)*, this study explores heterogeneity of DULCE effects (*for whom* DULCE works). We take advantage of earlier work that identified distinct family profiles of risks and strengths in the current study sample via Latent Profile Analysis (Byers et al., 2022). We examine how DULCE predicts family well-being outcomes (RQ1), identify how well DULCE's flexible tailoring strategy worked to deliver varying levels of support to families based on their need (RQ2), and test for heterogeneity of DULCE's effects across groups of families with different baseline profiles of risks and strengths and DULCE dosage (RQ3).

Methods

Sample and Data

This study used data collected during a larger, longitudinal study conducted to understand family, clinic, and community experiences of pediatric healthcare innovations designed to increase screening and referral for HRSNs. In that study, 908 families from 9 clinics participated, and all clinics implemented at least one of three different pediatric innovations (for details, see McCrae et al., 2021). Six of the 9 clinics implemented DULCE; 4 are included in the current study and 2 were excluded due to one's ceasing DULCE implementation and the other offering DULCE to all families, resulting in no comparison group in that clinic. Each included clinic is a Federally Qualified Health Center (FQHC), which are community-based health clinics that are federally funded to provide comprehensive primary care and supports in underserved areas or populations, regardless of ability to pay (Doty et al., 2020). The patient populations of all clinics included in this study are predominantly (> 90%) Medicaid insured or uninsured. In the current study, we explored the relationship between one pediatric innovation, DULCE, and caregiver agency, stress, and resilience. The analyses included 342 families with newborns — DULCE participants and a contemporaneous comparison group — that received care at four clinics implementing DULCE.

Enrollment Procedures

DULCE participation was offered to a subset of families using procedures intended to minimize selection bias. This study was not a randomized-control trial, so randomization could not be enforced at each clinic. However, the clinics

understood that introducing random or quasi-random enrollment into DULCE would greatly enhance the rigor of the study, so some clinics implemented their own processes for DULCE enrollment that enhance the integrity of study assignment. Two sites offered DULCE to families served by certain pediatric providers; another site enrolled babies with odd-numbered birthdays; the fourth site enrolled babies on certain days of the week. The number of families enrolled in the intervention and comparison group varied by site and was affected by clinic size and other factors that can act as a barrier to study participation, such as lack of interest or logistical concerns (e.g., time; George et al., 2014). Enrollment rates for the DULCE program were high; more than 95% of families offered DULCE participated in the intervention (Arbour et al., 2021).

Enrollment for the DULCE program and enrollment for the current research study were conducted separately. Families with a child aged 2 weeks through 6 months old from February 2018 to January 2020 were offered enrollment in the research study during their visit to the pediatric clinic, or within 4 weeks of their visit. Families were excluded if the newborn was hospitalized for more than 7 days after birth, caregivers were younger than 18 years, or caregivers did not speak English, Spanish, or Haitian Creole. The enrollment rate into the current research study is unknown because clinics did not track the number of families offered but declined to participate in the study. Of all families consenting to participate in the research study, however, 98% of families completed the baseline interview and 78% completed the final interview (McCrae et al., 2021). Regardless of DULCE participation and research study enrollment, families received all aspects of standard pediatric care.

Data

Data for this study came from two sources: survey interviews with parents and the DULCE program registry. Trained field interviewers conducted the surveys during in-person interviews in the clinic, home, or other preferred family location. Interviews typically lasted 60 min and were collected at three timepoints: baseline (0–6 months), midpoint (7–12 months) and final (12–15 months). The time frames for the assessments were chosen to match the age of enrollment into DULCE (baseline), length of DULCE intervention (6 months), and the maximum amount of follow-up that could be achieved uniformly given the study project period. Only baseline and final interviews were used in this study to ensure consistent measures available at each time point. Survey data included family demographic characteristics and experiences of risks and strengths.

Additionally, Family Specialists recorded family-level data about participation and experiences in DULCE in the DULCE program registry. Registry data included the date and type of each encounter, including well-child visits, sick visits, Family Specialist contacts (telephone calls, text messages and email messages with or on behalf of the family; face-to-face meetings not associated with clinic visits), and case reviews where a family was discussed. In addition, for each of seven HRSNs (food insecurity, employment/financial, housing instability, housing conditions, utilities, maternal depression, and intimate partner violence), Family Specialists recorded the date screening was completed, screening results (positive or negative), date that they discussed a resource, type of resource discussed, and when the family reported connecting to a resource.

Family Characteristics Measures

Baseline characteristics reported by caregivers included race, ethnicity, relationship status, household income,[1] and years living in the USA. In addition, we included an indicator of families' baseline risks and strengths. Previous work that used latent profile analysis (LPA) identified four family profiles: (1) complex risk, low strengths; (2) household and relational risk, low strengths; (3) neighborhood risk, high strengths; and (4) low risk, high strengths. The complex risk, low strengths profile was primarily distinguished by high exposure to poor housing quality, elevated neighborhood danger, and the highest level of neighborhood disorder; families in this profile also reported low scores on resilience, mastery, and social connectedness. The household and relational risk, low strengths profile was distinguished by high risk in the household including parental depression, substance use, and family violence; this profile also reported low levels of strengths like resilience and mastery. The neighborhood risk, high strengths profile was characterized by a high level of disorder and danger in neighborhoods but also higher levels of resilience, mobilizing resources, and social connectedness. Finally, the low risk, high strengths profile was distinguished by low exposure to neighborhood and household risk; this profile also reported the highest levels of strengths, including resilience, mastery, and social connectedness. More details about the latent profile analysis and measures used can be found in Byers et al. (2022).

A binary risk profile variable was created to contrast the low risk, high strengths profile with the three high-risk profiles (1–3 above). This binary indicator was used in longitudinal models that interacted risk profiles with DULCE dosage because group sizes were too small to reach convergence if maintaining the full risk profile variable. Baseline

[1] Income was measured as an ordinal variable: 0 (less than 15 k), 1 (greater or equal to 15 k, less than 25 k) 2 (greater than or equal to 25 k, less than 50 k), 3 (greater than or equal to 50 k, less than 100 k), 4 (greater than or equal to 100 k).

caregiver agency, stress, and resilience scores were used in the creation of the latent profiles, so profiles also served as a control for families' baseline agency, stress, and resilience.

DULCE Program Implementation Measures

DULCE Participation

All families who enrolled in the study and had data in the DULCE family registry ($n = 172$) formed the intervention group. Families in the comparison group were those who enrolled in the study but did not appear in the DULCE registry, and did not report participating in DULCE during the survey interview ($n = 170$).

HRSNs Screening, Referral, and Linkage

For social need, we calculated the screening rate (% of families screened among all DULCE-enrolled families), positivity rate (% of positive screens among families that were screened), resource provision rate (% of families with which a resource was discussed among families with a positive screen), and connection rate (% of families that connected with or received a resource among families with a positive screen and discussed resource). All families participating in DULCE should be screened for HRSNs, so the screening rate should be close to 100%.

DULCE Dosage

Dosage is the count of the total number of DULCE encounters documented for each infant during enrollment. The number of encounters ranged from 1 to 34. For analytic purposes, an ordinal variable was created that divided the sample roughly into thirds: (1) 1–5 (26%), (2) 6–10 (42%), and (3) 11–34 encounters (33%).

Outcome Measures

Caregiver agency (Healthy Families Parenting Inventory – Mobilizing Resources Subscale; HFPI-MR)

The HFPI-MR (LeCroy & Milligan Associates, Inc., 2004) is a five-item subscale, one of nine subscales of the 63-item self-report Healthy Families Parenting Inventory scale (HFPI). The mobilizing resources subscale reflects caregiver agency, or the ability to identify and access resources in their communities (range 1–25). The full scale has well-established psychometric properties (Krysik & LeCroy, 2012), and our sample showed a Cronbach's alpha estimate of 0.733.

Functional Impact of Toxic Stress on Parents (FITS-P)

The FITS-P (Moreno et al., 2021) is a 4-item self-report scale to assess parents' functional life impairment related to stress (range 0–4). It assesses the impact of stress on caregiver thoughts/emotions, behavior, schedule, and relationship with one's infant. Initial validation results find this measure to be well-validated and highly correlated with other measures of stress. Our sample showed a Cronbach's alpha estimate of 0.586. Explanation of this lower internal reliability and more validation details can be found in Moreno et al. (2021).

Connor Davidson Resilience Scale (CD-RISC)

The CD-RISC (Connor & Davidson, 2003) is a 25-item self-report scale of resilience (range 0–100), widely used across service systems and populations and with established psychometric properties (Connor & Davidson, 2003). Our sample showed a Cronbach's alpha estimate of 0.926.

Calculating percent change

Outcome measures were operationalized as the percent change in scores from baseline to final. We increased the range of the FITS-P and CD-RISC scales by one to eliminate the possibility of denominators of zero.

Analysis

Descriptive Statistics

To describe the sample, we calculated means and frequencies for family demographic characteristics, baseline family risk and strengths profiles, and baseline and final values for outcome measures. We tested for differences by DULCE participation using independent sample *t*-tests. To describe program implementation, we calculated frequencies for screening, positive screens, discussion of resources, and connection to resources. We calculated these frequencies, and the average total number of encounters, for all DULCE participants and for each risks and strengths profile.

Longitudinal Multi-level Modeling

For longitudinal analyses, we used multi-level modeling to account for nesting of families within clinics. Mixed effects models included fixed effects (direct estimations of associations between predictor and outcome variables) and random effects (indirect estimates of clinic effects). The random, clinic-level effects indicated how much variance in the outcome is accounted for by clinic differences after

controlling for explanatory variables and was measured by the intraclass correlation (ICC). We conducted four sets of longitudinal, mixed-effects models. The first used DULCE participation to predict changes in outcomes, and the second included the interaction of DULCE participation and the binary risk profile indicator to identify if risks and strengths at baseline moderate the association between participation and outcomes. The third analysis used DULCE dosage to predict changes in outcomes, and the fourth used the interaction between dosage and risk profile to predict changes in outcomes. In the models using interaction terms, the coefficients for DULCE and DULCE dosage without an interaction can be interpreted as the associations of DULCE participation or dosage with a given outcome when the moderating variable is zero; in this case, the moderating variable being zero indicates low-risk families. The interaction coefficients can then be interpreted as the associations of DULCE and dosage with a given outcome for high-risk families in comparison to low-risk families.

Missing Data

Attrition was small ($n = 181$; 22%) from baseline to final. Survey weights were calculated to adjust for bias due to attrition. Logistic regression was used, regressing final survey completion on key demographic characteristics (e.g., income, household size). Results of this analysis identified the probability of a family to complete the final survey. A survey weight that is the inverse of this probability was then applied to all longitudinal analyses. This helps mitigate attrition bias by adjusting coefficients to reflect the demographic distribution of the sample at baseline.

Missing data were a small concern in the current survey. Demographic data were complete except for 13% missing information on annual income and responses missing at random to one or two items on a scale. Mean imputation was used to address missing income data. Scale scores were calculated using data present; if more than 25% of items were missing, a score was not given. For this reason, one family was excluded for analyses predicting caregiver agency and the impact of stress; two were excluded for analyses predicting resilience.

Results

Descriptive results

DULCE Participants

Table 1 shows the distribution of families across DULCE clinics, and means and frequencies for family demographics, risks and strengths profiles, and baseline and final outcomes. Intervention and comparison group families were distributed differently across clinics—Clinics 1 and 2 included more comparison families; Clinics 3 and 4 included more DULCE families.

DULCE participant and comparison families did not significantly differ in infant gender, race/ethnicity, relationship status, and income. DULCE families did report significantly fewer years spent in the USA than comparison families. There were no significant differences in families' baseline risks and strengths profiles by intervention status, suggesting that families in these groups had similar prior experiences of risks and strengths.

Two of three outcome measures showed no significant differences at baseline or follow-up, without controlling for covariates or clustering. Caregiver agency at baseline was similar for families in DULCE ($M = 18.7$, SD 0.31) and the comparison group ($M = 19.08$, SD 0.33). These values reflect moderate levels of agency. Agency increased over time for both groups and remained at a moderate level with a statistically indistinguishable difference.

Similarly, there were no significant differences in caregivers' reported impact of stress on daily functioning by intervention status. In both groups, at baseline, caregivers reported stress in two of four domains of daily functioning (thoughts/emotions, behavior, schedule, relationship with infant). At follow-up, all families reported lower levels of the impact of stress, and there was no difference between DULCE and comparison groups.

In contrast, there was a statistically significant difference in baseline resilience. DULCE families reported lower baseline resilience (78.25) than comparison families (81.76). Using this scale, the average resilience score in the general population was 80.7, so DULCE families reported resilience just below the population average, and comparison families reported resilience just above. Over time, resilience increased for DULCE families (79.21) and decreased for comparison families (78.54).

DULCE Implementation/Process Measures

Table 2 describes DULCE program measures. The screening rate for the core DULCE screening domains (food insecurity, employment/financial, housing instability, utilities, maternal depression, IPV) ranged from 92 to 97%; 70% of families were screened for unhealthy or unsafe housing conditions and 72% for smoking. Rates of positive screens varied, with the highest rates for food insecurity (45%) and employment/financial (34%). Resources were discussed with nearly all families with positive screens (80–100%), and the rates of successful resource connection ranged from 50 to 92%, as recorded by FS.

Table 3 shows program experiences for DULCE families overall, and for families by risks and strengths profiles.

Table 1 Family Characteristics by DULCE participation

	DULCE ($n=172$) % (N) | M (SE)	Comparison[a] ($n=170$) % (N) | M (SE)	*T*-test
Clinic			
1	20.3 (35)	42.4 (72)	***
2	7.0 (12)	17.6 (30)	**
3	33.1 (57)	11.8 (20)	***
4	39.5 (68)	28.2 (48)	*
Baseline characteristics			
Female infant[b]	50.0 (74)	55.7 (73)	
White	0.6 (1)	1.2 (2)	
Black	9.9 (17)	15.9 (27)	
Hispanic	80.2 (138)	78.2 (133)	
Other race[c]	8.7 (15)	4.1 (7)	
Single	37.8 (65)	38.8 (66)	
Income < 15k	19.2 (33)	20.6 (35)	
15k <= Income < 25k	36.6 (63)	35.9 (61)	
25 <= Income < 50k	23.3 (40)	24.1 (41)	
50k <= Income < 100k	7.0 (12)	5.3 (9)	
100k <= Income	1.7 (3)	0.6 (1)	
Years in USA	18.19 (0.85)	20.75 (0.83)	*
Risks and Strengths Profiles[d]			
Complex risk exposure, lower strengths	9.3 (16)	4.7 (8)	
High exposure to household and relational risk, lower strengths	16.3 (28)	20.0 (34)	
High exposure to neighborhood risk, higher strengths	15.7 (27)	13.5 (23)	
Low exposure to risk, higher strengths	58.7 (101)	61.8 (105)	
Dichotomous Indicator for Long. Analysis			
High risk profile	41.3 (71)	38.2 (65)	
Outcomes			
Caregiver agency (high = more agency)			

Table 1 (continued)

	DULCE ($n=172$) % (N) | M (SE)	Comparison[a] ($n=170$) % (N) | M (SE)	*T*-test
Baseline	18.68	19.08	
	(0.31)	(0.33)	
Final	19.82	19.57	
	(0.35)	(0.32)	
Impact of stress (high = more impact)			
Baseline	2.01	1.93	
	(0.08)	(0.08)	
Final	1.82	1.81	
	(0.09)	(0.09)	
Caregiver resilience (high = more resilience)			
Baseline	78.25	81.76	*
	(1.19)	(1.07)	
Final	79.21	78.54	
	(1.11)	(1.34)	

Standard errors in parentheses

$^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$

[a]This comparison group includes all individuals in the clinic sample who did not participate in DULCE or I-SCRN and received care at a DULCE clinic

[b]Denominator for percentage is different for infant gender due to missing data: DULCE innovation group ($n=148$); comparison group ($n=131$)

[c]Other race includes Asian, Native American, Pacific Islander, other, and mixed race

[d]Risks and strengths profiles were created using Latent Profile Analysis and the following baseline variables: housing instability and quality, neighborhood quality, impact of stress, environmental adversity, agency, resilience, Mastery, And Social Connection. For detail, See Byers et al. (2022)

On average, DULCE families received 10 encounters and screened positive for one health-related social need. Eighty-eight percent of families who screened positive for health-related social needs had resources discussed and offered, and 77% connected with a resource according to FS. Families in the higher-risk profiles — complex risk and low strengths; high household risk, lower strengths; high neighborhood risk, higher strengths — screened positive for social care needs more often (70–82%) compared to families with low risk and higher strengths (63%). Notably, families in the higher-risk profiles had higher rates of linking to services (90.9%, 85.7% and 84.2%, respectively) than families with low risk and higher strengths (67.9%). Finally, we examined how the number of encounters differs across family profiles of risks and strengths. As intended, families in higher-risk profiles had more encounters with DULCE as compared to the low risk, high strength profile families. Taken together, these patterns address our second research question by identifying that higher-risk families received more intensive DULCE supports and more successfully

Table 2 Positive screening results and rates of resource referral and linkage

Screening type	% Screened (N)	% Positive (N)	% Discussed resource (N)	% Discussed and received resource (N)
Required screens				
Food insecurity	97.1 (167)	44.9 (75)	97.3 (73)	82.2 (60)
Employment/Financial	96.5 (166)	44.0 (73)	61.6 (45)	51.1 (23)
Maternal depression	93.0 (160)	23.8 (38)	94.7 (36)	55.6 (20)
Housing instability	95.9 (165)	7.9 (13)	92.3 (12)	33.3 (4)
IPV	95.4 (164)	4.9 (8)	87.5 (7)	42.9 (3)
Housing conditions	70.4 (121)	4.1 (5)	40.0 (2)	100.0 (2)
Smoking	71.5 (123)	4.1 (5)	40.0 (2)	0.0 (0)

$N=172$. The denominator for "% discussed resource" and "% discussed and received resource" columns come from the N reported in the previous column

Table 3 Differences in DULCE experiences by profile of risks and strengths

Class	N	%	Average # positive screens (SD)[B,D,F]	N positive (%)[B]	N discussed resource (%)	N discussed and received resource (%)[D]	Average # of encounters[*] (SD)
All families	172	100	1.43 (1.37)	118 (68.6)	104 (88.1)	80 (76.9)	10.0 (5.61)
Complex risk, low strengths (CR, LS)	16	9.3	2.19 (1.94)	12 (75.0)	11 (91.7)	10 (90.9)	10.25 (5.21)
Household risk, low strengths (HR, LS)	28	16.3	1.79 (1.37)	23 (82.1)	21 (91.3)	18 (85.7)	10.75 (6.07)
Neighborhood risk, high strengths (NR, HS)	27	15.7	1.85 (1.59)	19 (70.4)	19 (100.0)	16 (84.2)	10.85 (6.47)
Low risk, high strengths (LR, HS)	101	58.7	1.10 (1.09)	64 (63.4)	53 (82.8)	36 (67.9)	9.58 (5.33)

The denominator for the reported percentages is the N from the previous column in the corresponding row

[*]Encounters is the number of encounters documented for each infant during DULCE enrollment. Encounters included WCVs, sick visits, FS contacts (telephone calls, text messages and email messages with or on behalf of the family; face-to-face meetings not associated with clinic visits), and case reviews where family was discussed

A = sig difference between HR, LS and CR, LS

B = sig difference between HR, LS and LR, HS

C = sig difference between HR, LS and NR, HS

D = sig difference between CR, LS and LR, HS

E = sig difference between CR, LS and NR, HS

F = sig difference between NR, HS and LR, HS

connected to resources, demonstrating that the DULCE program tailors services and supports to identified family needs.

Longitudinal Results

Outcome 1: Caregiver Agency

Model 1A shows that DULCE participation was associated with a statistically significant 7% increase in caregiver agency (Table 4). Covariate coefficients show that, independent of DULCE participation, Black and Hispanic families (as compared to White families), families with more years in the USA (as compared to more recent immigrants), and families experiencing high household risk, low strengths (as compared to families with low risk, high strengths) were significantly more likely to experience increases in agency over time during their children's first years.

Model 1B includes the interaction of DULCE participation with the binary risk profile variable. DULCE participation was associated with a statistically significant 9% increase in caregiver agency for low-risk families. The interaction term is not significant, indicating that DULCE participation was not associated with additional significant increases in caregiver agency for high-risk families compared to low-risk families. Higher-risk families experienced larger increases in agency over time during infancy compared with low-risk families, independent of DULCE.

Model 2A examines DULCE dosage and changes in outcomes. For caregiver agency, low (1–5 encounters) and moderate (6–10) encounters were associated with a 12% and 11% increase in caregiver agency. Similar to Model 1A, independent of DULCE participation, families in the household risk profile experienced a 16% increase in agency. Model 2B, which includes the interaction between DULCE dosage and the binary risk profile variable, shows similar associations between low and moderate dosage as Model 2A, and no interaction terms were significantly associated with increases in agency, suggesting that there was no additional benefit of greater DULCE dosage for high-risk compared to low-risk families.

Outcome 2: Impact of stress

Model 1A shows that DULCE families experienced a decrease in the impact of stress, but this did not reach statistical significance. Independent of DULCE participation, families with complex risks, low strengths and high household risk, low strengths experienced 31–35% decreases in the impact of stress compared to low-risk, high strength families. There were no other significant associations between covariates and reductions in the impact of stress.

Model 1B includes the interaction term for DULCE participation and the binary risk profile variable. In this model, DULCE participation was associated with a statistically significant 15% decrease in the impact of stress among families

Table 4 Multilevel models predicting caregiver agency, stress, and resilience

	% Change in caregiver agency	% Change in impact of stress	% Change in resilience
MODEL 1A: DULCE participation			
DULCE	0.07*	−0.06	0.10*
	(0.03)	(0.07)	(0.04)
CR, LS	0.05	−0.31**	0.07
	(0.11)	(0.11)	(0.05)
HR, LS	0.16*	−0.35***	0.07
	(0.07)	(0.06)	(0.04)
NR, HS	0.02	−0.14	−0.01
	(0.05)	(0.15)	(0.02)
Black	0.23***	−0.27	−0.01
	(0.07)	(0.15)	(0.04)
Hispanic	0.12***	−0.13	−0.02
	(0.02)	(0.20)	(0.03)
Other race	0.06	−0.12	−0.04
	(0.06)	(0.09)	(0.03)
Single	−0.03	0.09	−0.03
	(0.04)	(0.06)	(0.03)
Household income	0.01	0.03	−0.01
	(0.01)	(0.02)	(0.03)
Years in USA	0.03*	0.05	0.02**
	(0.01)	(0.04)	(0.01)
Constant	−0.11***	0.31 +	−0.02
	(0.03)	(0.16)	(0.07)
Observations	306	306	305
Number of groups	4	4	4
ICC	0.006	0.008	0.012
95% CI	[0.01, 0.12]	[0.01, 0.31]	[0.02, 0.04]
MODEL 1B: Interaction of DULCE participation and high-risk family profiles			
DULCE	0.09***	−0.15**	0.08
	(0.01)	(0.05)	(0.05)
Higher-risk classes	0.11**	−0.37*	0.02
	(0.04)	(0.15)	(0.02)
DULCE X Higher-risk	−0.05	0.24	0.05
	(0.07)	(0.19)	(0.03)
Constant	−0.09***	0.33	0.00
	(0.02)	(0.21)	(0.07)
Observations	306	306	305
Groups	4	4	4
ICC	0.008	0.007	0.015
95% CI	[0.01, 0.12]	[0.01, 0.33]	[0.02, 0.04]
MODEL 2A: DULCE dosage			
# of Encounters			
1–5	0.12***	−0.19*	0.11***
	(0.01)	(0.09)	(0.02)
6–10	0.11**	−0.08	0.10*
	(0.04)	(0.10)	(0.04)
11–34	0.03	0.02	0.09
	(0.06)	(0.09)	(0.06)
CR, LS	0.06	−0.33**	0.08
	(0.11)	(0.11)	(0.05)

Table 4 (continued)

	% Change in caregiver agency	% Change in impact of stress	% Change in resilience
HR, LS	0.16*	−0.34***	0.07
	(0.07)	(0.05)	(0.04)
NR, HS	0.03	−0.15	−0.01
	(0.04)	(0.15)	(0.02)
Constant	−0.11***	0.30*	−0.02
	(0.02)	(0.14)	(0.07)
Observations	306	306	305
Number of groups	4	4	4
ICC	0.016	0.000	0.016
95% CI	[0.01, 0.16]	[0.00, 1.24]	[0.02, 0.04]
Model 2B: Interaction of DULCE dosage and high-risk family profiles			
# of Encounters			
1–5	0.14***	−0.37***	0.11***
	(0.01)	(0.08)	(0.03)
6–10	0.11***	−0.10	0.09*
	(0.03)	(0.14)	(0.04)
11–34	0.04	−0.07	0.04
	(0.05)	(0.09)	(0.07)
Higher-risk classes	0.11**	−0.37*	0.02
	(0.04)	(0.15)	(0.02)
1–5 X Higher-risk	−0.03	0.45***	0.02
	(0.04)	(0.12)	(0.02)
6–10 X Higher-risk	−0.03	0.05	0.05
	(0.10)	(0.14)	(0.02)
11–34 X Higher-risk	−0.05	0.22	0.09*
	(0.05)	(0.29)	(0.04)
Constant	−0.09***	0.36	−0.00
	(0.02)	(0.20)	(0.07)
Observations	306	306	305
Groups	4	4	4
ICC	0.021	0.000	0.025
95% CI	[0.01, 0.16]	[0.00, 4.20]	[0.02, 0.05]

Standard errors in parentheses. *CR, LS*, complex risk exposure, lower strengths; *HR, LS*, high household/relational risk, lower strengths; *NR, HS*, high neighborhood risk, higher strengths

Higher-risk profiles = complex risk, lower strengths; household/relational risk, lower strengths; neighborhood risk, higher strengths

$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.00.1$

with the lowest risk profile, and no significant association was found between DULCE participation and the impact of stress among families with higher risk. Similar to Model 1A, higher-risk families experienced a significant decrease in the impact of stress compared to low-risk families, regardless of DULCE participation.

Model 2A shows low (1–5 encounters) dosage was associated with a 19% reduction in the impact of stress, and moderate and high dosage had no significant relationship with reductions in stress. Similar to Model 1A, families experiencing complex and household risk experienced reductions in the impact of stress, regardless of DULCE participation. Model 2B shows a larger and significant association between low dosage and decreases in the impact of stress (37%) for low-risk families. Notably, while higher-risk families still experienced decreases in the impact of stress regardless of DULCE dosage, higher-risk families with *low* dosage experienced an increase in the impact of stress.

Outcome 3: Resilience

DULCE participation was associated with a 10% increase in caregiver resilience (Model 1A). Covariate coefficients show that families who lived more years in the USA experienced a small but significant increase in resilience, independent of DULCE participation. There were no associations between risks and strengths profiles at baseline and change in resilience.

Model 1B shows no association between DULCE participation and caregiver resilience for the lowest risk families, and a positive association between DULCE participation and resilience for the higher-risk families at the trend level of significance.

When examining the associations of DULCE dosage, Model 2A shows that low dosage was associated with an 11% increase in resilience, moderate dosage was associated with a 10% increase in resilience, and no association was found at highest dosage. Model 2B shows significant increases in resilience at low and moderate dosage for low-risk families. Importantly, higher-risk families with *high* dosage experienced an additional 9% increase in resilience.

Clinic effects

Across all models, clinics account for 0–2.5% of variance in outcomes. Importantly, after controlling for these differences, DULCE participation remained significantly associated with changes in families' outcomes.

Discussion

This study's findings suggest that DULCE was associated with positive changes in caregiver strengths, offering support for the impact of DULCE on its theorized mechanism of action — fortification of Strengthening Families' Protective Factors. Previous studies demonstrated that DULCE increased on-time well-child visits, immunizations, and access to concrete supports and behavioral health resources (Arbour et al., 2021, 2023; Sege et al., 2015); this study complements that work by demonstrating that DULCE participation during pediatric well-child visits is associated with positive changes in caregiver agency, stress, and resilience.

In response to RQ1, findings demonstrate that, on average, DULCE participation was associated with a 10% increase in resilience and a 7% increase in agency. These analyses show improvements in caregiver strengths as a benefit of DULCE participation regardless of baseline experiences of risks and strengths, underscoring the value of DULCE's universal approach. Indeed, earlier work estimated that DULCE's universal approach identified and reached 75% more families with HRSN than a targeted approach might (Arbour et al., 2022).

Findings from program data and mean comparisons show that DULCE achieved high screening rates across screening types and referred and connected families to services at a high rate. In response to RQ2, results demonstrated that DULCE served highest-need families more and connected them most often to resources. DULCE is designed to allow families to drive the amount of intervention they receive, and findings from this study suggest that, in the context of a relational intervention, a tailoring strategy based primarily on families' preferences can deliver support of varying intensity and achieve positive outcomes for families.

Finally, answering RQ3 showed that testing for heterogeneity in the effects of an intervention is important for better understanding how a program works and for whom. Interacting DULCE participation with a binary risk-profile indicator showed increases in agency and reductions in stress for low-risk families participating in DULCE, but no additional benefit for high-risk families participating in DULCE.

In addition, dosage matters. Even at low dosage (5 encounters or less in 6 months), positive associations were seen with the impact of stress and resilience for all families on average, suggesting that benefits emerge early in DULCE involvement. Moderate dosage led to significant increases in agency, overall. Families in the higher-risk groups demonstrated additional benefit from the highest dosage level, with additional increases in resilience. Improvements in agency and the impact of stress were strongest for low-risk families, and improvements in resilience were strongest for high-risk families. These variations in the associations between DULCE dosage and outcomes on average and by risk profiles suggest that dosage had varying impacts on outcomes based on previous experiences of risks and strengths; therefore, the influence of the highest level of dosage was not evident when looking at the sample as a whole. These moderating effects of family profiles suggest that DULCE's tailoring approach that invites families to drive the dosage of their services works: families with greater risk tend to engage more intensively with DULCE and access more intervention support, which pays off for improving resilience. Simultaneously, families with lower adversity received a lighter touch intervention, with positive effects on important outcomes for them as well.

Notably, across the models developed to address the research questions of this study, race and ethnicity were associated with caregiver outcomes, independent of DULCE intervention. Black and Hispanic families showed increases in agency and resilience compared to white families; families of color in this sample demonstrated significant growth in protective factors over their infants' first year. This is an important finding that highlights the strengths of families,

particularly families of color, to adapt and thrive in a nation that has institutional biases and often challenges their access to resources (Subramaniam et al., 2017). Finally, across all models, the relatively small influence of clinic context on outcomes suggests the facilitation of DULCE spread through Continuous Quality Improvement (CQI) allowed local teams to make adaptations in DULCE delivery while maintaining fidelity to the innovation's core elements.

Limitations

Several limitations warrant mention. Despite efforts to minimize selection bias with quasi-random DULCE enrollment (e.g., by offering DULCE participation on specific day of the week or provider), the sample was not randomly selected. Clinics did not track patients that were offered research study participation and did not consent, resulting in an unknown enrollment rate for the study population (specifically, for the comparison group). There may be selection bias that is not completely controlled for by inclusion of covariates. DULCE and non-DULCE families differed in the number of years spent in the US (18 vs 21), which might bias estimates of impact on physical and mental health outcomes. However, this is less likely since health benefits associated with recent immigration typically dissipate after 10 years (Salazar et al., 2016).

The magnitudes of DULCE's effects are modest and, for some outcomes, may be related to measurement issues. The measure of stress used in this study was very brief and varied little over time. Future studies might consider adding another well-validated measure of stress. Finally, while this study is testing the associations of DULCE with caregiver outcomes hypothesized to be mechanisms for how DULCE impacts longer-term outcomes like emergency room utilization and child health outcomes, we were not able to conduct mediation models to explicitly test the mechanistic pathway. Future studies should leverage longer follow-up windows to measure the extent to which caregiver agency, stress, and resilience act as mediators in DULCE's effects on child health outcomes.

Implications and Conclusions

This study expands on prior research demonstrating the value of DULCE by examining how DULCE works, and for whom it works, in pediatric settings. DULCE's positive associations with caregiver resilience and agency are noteworthy not only because of their potentially far-reaching effects on families' lives, but also because increases in resilience and agency provide evidence for DULCE's hypothesized mechanism of action — that relational care and cross-sector engagement in pediatric clinics fortifies families' protective factors in ways that enable families to engage in care and navigate care systems more effectively. The second finding — that dosage tailored in response to families' preferences resulted in highest-risk families receiving most intensive services, lower-risk families receiving less intensive services, and all families experiencing benefit — lends confidence to DULCE's mechanism for offering services universally to pediatric populations and engaging in family driven, relational tailoring of service intensity, thus underscoring the value of pediatric clinics implementing an intervention like DULCE. Finally, variation in associations by families' baseline risk and strengths profiles provides a model for how prevention interventions can and should examine heterogenous effects; not only by readily available demographic characteristics or observable characteristics, but also by measuring and defining meaningful subgroups for whom interventions might have varying impact. This allows for the identification of what works best, for whom, and how — and to do better with and for all families.

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Declarations

Ethics Approval This study was approved by the Institutional Review Board of the School of Social Service Administration at the University of Chicago and was conducted in accordance with tenets of the Declaration of Helsinki.

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors declare that they have no conflict of interest.

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