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Collateral benefits from a school-readiness intervention on breastfeeding: A cross-domain impact evaluation

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Abstract

This study evaluated the collateral, or unanticipated, impacts of Smart Beginnings (SB), a two-site, tiered intervention designed to promote responsive parenting and school readiness, on breastfeeding intensity in a low-income sample. Impact analyses for the SB intervention were conducted using an intent-to-treat design leveraging a two-arm random assignment structure. Mothers assigned to the SB intervention group were more than three times more likely to give breastmilk as the only milk source at infant age 6 months than mothers assigned to the control group at one site, an effect not evident at the other study site. As development and growth are the two most salient domains of child health, understanding how interventions impact subsequent parenting practices across both domains is critical to address long-term economic and racial/ethnic disparities. Implications of the findings are discussed for improving the efficacy of interventions based on paediatric primary care.

KEYWORDS
breastfeeding, collateral impacts, intervention effects

1 | INTRODUCTION

Poverty-related disparities in children's health and cognitive and socio-emotional development are well documented, beginning in early childhood and continuing throughout the lifespan (Dreyer, 2020). In the United States, paediatric primary care offers a unique platform for the delivery of preventive interventions beginning in infancy before disparities arise, by providing near-universal access, high levels of engagement, and population-impact at low cost (American Academy of Pediatrics [AAP], 2016). Primary care-based interventions to promote infant and toddler health and nutrition, therefore, have a long history in the United States (Bartholomew et al., 2017), as do programmes for promoting responsive parenting practices and early learning for young children (Peacock-Chambers et al., 2017), as development and growth are two early processes critical for later child outcomes (Gross et al., 2021).

Traditionally, interventions aimed at improving early childhood nutrition—including programmes that promote breastfeeding or

responsive infant feeding behaviours—and interventions aimed at promoting responsive parenting practices or early child learning have been delivered and evaluated separately (Batura et al., 2015). However, newer intervention models that combine components of nutrition and early learning have emerged in the past several decades both in the United States and abroad, based on evidence that positive changes in one domain of a child's early development often cascade into other domains (Batura et al., 2015). In fact, synergistic effects are sometimes evident when components are combined into a single intervention model (Black et al., 2015; Grantham-McGregor et al., 2014). Nonetheless, there remains potential for a more coordinated and comprehensive use of the paediatric primary care platform to address both nutrition and early learning, as many families with low incomes would benefit from primary prevention related to both development and growth. Furthermore, understanding the mechanisms by which parenting or early learning programmes produce outcomes in unanticipated but important other domains can help researchers understand the basic processes involved in promoting both healthy growth and early learning, and assist programme implementers in adapting interventions across contexts to maximise positive outcomes (Oliver et al., 2019). Using data from the Smart Beginnings (SB) trial, an ongoing randomized controlled trial (RCT) testing the efficacy of a tiered parenting intervention to increase children's school readiness among families with low incomes using paediatric primary care, the current study assesses the collateral (i.e., unanticipated) impact of SB on breastfeeding—a critical infant nutrition outcome related to both development and growth in early childhood (Victora et al., 2016) that was outside the original programme goals.

Key messages

- We found that the Smart Beginnings (SB) intervention increased the rates of providing breast milk as the only milk source in the study site with low initial rates of breastfeeding. Our study contributes to the small, but growing, literature on the potential health benefits of early learning interventions and extends these findings to breastfeeding, a key indicator of infant nutrition. It further adds to the study of collateral programme benefits in adapting interventions across contexts and maximizing positive outcomes.
- The policy implications of our study indicate how the medical home model of care can leverage limited resources for intervention delivery. Collateral benefits to additional outcomes, combined with programmatic knowledge, suggest that school readiness parenting programmes like SB may have impacts beyond child development. This study further adds to a growing literature that parenting interventions based in paediatric primary care may lead to synergistic effects across domains using a single intervention model.
- These findings illustrate that primary care clinics that host parenting interventions may leverage resources with cross-domain spillover effects in mind, as collateral benefits can continue to provide helpful information about integrated models more broadly.

1.1 | Importance of breastfeeding for maternal and child health

Increasing rates of breastfeeding initiation, duration, and exclusivity are important public health goals (Kramer & Kakuma, 2012), as the health benefits of breastfeeding to mothers and infants are far-reaching (Victora et al., 2016; World Health Organization, 2021). For mothers, breastfeeding has been associated with lower maternal risks of breast cancer, ovarian cancer, diabetes, hypertension, and heart disease (American College of Obstetricians and Gynecologists, 2018; Meek et al., 2022; Victora et al., 2016). For infants, health benefits include the reduced risk of infectious diseases (e.g., acute otitis media, respiratory tract infections, and gastrointestinal infections), chronic illnesses (e.g., asthma and eczema), sudden infant death syndrome, childhood obesity, and neurocognitive delays (American College of Obstetricians and Gynecologists, 2018; Meek et al., 2022; Victora et al., 2016). Based on these two-generational health benefits, the World Health Organization (WHO) and AAP recommend that infants are exclusively breastfed for at least 6 months to optimise maternal and infant health, and later child development and growth (Meek et al., 2022; WHO, 2021).

1.2 | Racial and ethnic disparities in breastfeeding

Despite the well-documented benefits of breastfeeding for both mothers and children (Victora et al., 2016; World Health Organization, 2021), racial and ethnic disparities in breastfeeding rates in the United States remain (Centers for Disease Control and Prevention [CDC], 2018). Black/African American mothers currently face increased barriers to breastfeeding compared with white mothers in the United States, including a lack of breastfeeding-friendly employment opportunities, inadequate support and more discrimination from health care providers, as well as a dearth of cultural and social acceptance for exclusive breastfeeding stemming from slavery and a history of forced wet nursing in the United States (Jones et al., 2015; Louis-Jacques et al., 2020). Latinx mothers also face unique barriers to meeting breastfeeding benchmarks and accessing breastfeeding supports, including issues related to acculturation, language, material deprivation related to immigration status, and early supplemental use of infant formula (Chapman & Pérez-Escamilla, 2012; Jones et al., 2015). As the factors leading to reduced rates of breastfeeding duration and breastfeeding exclusivity may vary by racial and ethnic background, and the SB samples from New York City (NYC) and Pittsburgh vary significantly in their racial and ethnic makeup (see Section 2 below), intervention impacts may vary by intervention site based on these racial/ethnic differences.

1.3 | Effects of parenting and child development programmes on health outcomes

1.3.1 | Unanticipated effects on child weight and obesity

A handful of studies utilizing parenting interventions during early childhood (birth to age 5 years) to promote child development have found unanticipated positive collateral intervention effects on child weight and obesity outside of the original programme goals. The platform for delivery of these parenting programmes has varied considerably, spanning from early childhood education to home visiting to pediatric primary care.

In early childhood education, participation in the Carolina Abecedarian Project from birth to age 5 years was linked to reductions in childhood obesity during pre-school and improvements in metabolic and cardiovascular health in adulthood (Campbell et al., 2014). In younger children at kindergarten entry, ParentCorps showed impacts on obesity among poorly regulated children in preadolescence (Brotman et al., 2012). Additionally, Lumeng et al. (2015) found that pre-school-age children with an unhealthy weight who participated in Head Start had a significantly healthier body mass index (BMI) by kindergarten entry compared with children who did not participate. Through home visiting, participation in the family check-up (FCU) from ages 2 to 5 was shown to have collateral effects on reduced BMI from ages 5 to 9.5 (Smith et al., 2015). In the same study, FCU intervention effects were also found on dietary quality at age 4 observed during a meal preparation task (Montaño et al., 2015). Participation in Minding the Baby prenatally through age 2 showed reductions in child obesity at age 2 years (Ordway et al., 2018). Lastly, in pediatric primary care, HealthySteps promoted healthy responsive feeding styles and healthy weight status at child age 5 for children at risk for poor socio-emotional development (Gross et al., 2015).

1.3.2 | Impacts on feeding-related primary outcomes

While this emerging body of literature has explored the indirect effects of early childhood parenting programmes on child weight and obesity, evaluating their impact on feeding-related primary outcomes remains relatively rare, specifically for breastfeeding outcomes. In fact, only a couple of parenting intervention studies have explored intervention impacts on breastfeeding during infancy with mixed results. For example, participation in HealthySteps was associated with increased rates of breastfeeding at infant age 3 months (Johnston et al., 2004), whereas Minding the Baby found no differences in duration of exclusive breastfeeding rates in infancy for treatment families compared with controls (Ordway et al., 2018). Understanding whether and how early parenting programmes might impact breastfeeding—a key nutrition outcome in infancy—is important based on the positive effects that exclusive breastfeeding can have on both maternal and child health that extend far beyond healthy weight gain or obesity prevention (Victora et al., 2016; World Health Organization, 2021).

1.4 | SB—Enhancing school readiness through the promotion of positive parenting

SB is designed as a tiered intervention to promote positive parenting by combining a universal primary prevention programme based on pediatric primary care (Video Interaction Project [VIP]; Mendelsohn et al. 2005) with a secondary prevention home-visiting programme for families with additional risk child and family risk factors (e.g., parental depression, low social support, and/or literacy) for low school readiness (the FCU]; Dishion & Stormshak, 2007). Both VIP and the FCU were delivered by trained interventionists.

VIP was conceived as an enhancement to Reach Out and Read and involves up to 14 one-on-one sessions with a bachelor's-level interventionist that takes place in the pediatric primary care clinic at the time of well-child visits between birth and 36 months. During each session, the interventionist encourages the parent to be an active observer of their child's development through discussion of recent and upcoming milestones. They then provide a developmentally appropriate toy or book and discuss with the parent how they can play with the toy to encourage child development. The parent and child are then recorded for 3–5 min of play together with the toy or book, after which the interventionist reviews the video with the parent in real-time, reinforcing responsive parenting and discussing ways they can extend these behaviours at home. To emphasise messaging and encourage parents to discuss sessions with other caregivers, a copy of the video and a personalised pamphlet with goals for parent–child interactions are provided at the end of the session.

The FCU is a brief (i.e., three to four sessions per year), targeted preventive intervention that employs a Master's-level parent consultant who incorporates motivational interviewing (MI) to engage families in making changes to their caregiving practices, and if desired, support in learning new parenting skills to address problematic child behaviour. The FCU consists of (1) a comprehensive, ecological assessment using normed measures, as described above; (2) a rapport-building "Get-to-Know-You" interview that focuses on building a collaborative framework and incorporating MI for subsequent intervention, and (3) a feedback session where the parent consultant continues to use MI in summarizing results to generate dissonance for the parent between the child's current status and the parent's aspirations for the child. Parents then have the option to engage in follow-up treatment sessions focused on achieving targeted goals identified by the parents.

The combined SB model is currently under study in a two-site RCT in New York City, NY and Pittsburgh, PA, extending prior findings of their independent intervention programmes in a single-tiered model across racially and ethnically diverse families. The primary aim of the SB trial is to test the impact of the tiered approach on proximal parenting outcomes and later school readiness outcomes

for families with low incomes. Results from target children ages 6–24 months demonstrated increased parental support for cognitive stimulation based on parent surveys and observations of parent–child interactions (Miller et al., 2022). A secondary aim of the SB trial is to test the efficacy of the model across its two urban sites that include families with vastly different demographic profiles and facing distinct vulnerabilities for their children's school readiness (Roby et al., 2021). For example, families in NYC are primarily immigrant Latinx, whereas families in Pittsburgh are predominantly Black/African American. Testing collateral impacts of the SB intervention across a broader population at two urban sites diverse in both location (NYC and Pittsburgh) and race/ethnicity allows us to explicitly examine setting-by-treatment interactions and assess the generalisability of the intervention.

In addition to their intended impacts, both VIP and the FCU have previously demonstrated potential pathways related to increased healthy parental feeding practices. For instance, VIP has been shown to reduce negative attitudes about infant feeding, an intervention effect that was mediated by improvements in the parent–child relationship (Katzow et al., 2019). In addition, in older children, the relationship between FCU participation and healthy school-age weight was mediated through improvements in positive parenting (Smith et al., 2015), as were group differences in parent's selection of dietary quality during a meal preparation task during the pre-school period (Montaño et al., 2015). In addition, other secondary analyses with the SB data indicated that higher intensity breastfeeding at 6 months was concurrently related to higher maternal sensitivity and lower maternal intrusiveness (Whipps et al., 2020). See Figure 1 for a full concept diagram detailing the pathways by which the SB intervention might lead to changes in proximal family assets and vulnerabilities related to development and growth, including breastfeeding, which in turn is hypothesised to lead to positive child outcomes (Gross et al., 2021).

1.5 | Breastfeeding, maternal caretaking, and parental support for cognitive simulation

Research has indicated that responsive and sensitive caretaking behaviours have been linked to more exclusive breastfeeding, while intrusive maternal–child interaction styles have been linked to concurrently decreased exclusivity in breastfeeding, including in the current SB sample (Britton et al., 2006; Whipps et al., 2020). Breastfeeding has also been associated with increased concurrent engagement in more positive mother–child interactions during both feeding and play activities, including the fostering of social-emotional and cognitive growth (Bigelow et al., 2014; Kuzela et al., 1990), as well as longitudinal maternal sensitivity through child age 11 (Weaver et al., 2018). These relationships may also be bidirectional; that is, breastfeeding may both predict and be predicted by sensitive and responsive caretaking in infancy and parental support for cognitive stimulation (Bigelow et al., 2014; Kuzela et al., 1990; Weaver et al., 2018).

Although it is difficult to determine the directionality of these associations, given that breastfeeding temporally must begin shortly after birth to be successfully sustained, a growing body of research exists to understand potential mechanisms through which breastfeeding and parenting are related. Kim et al. (2011) found that breastfeeding was associated with greater activation of the maternal brain regions linked to responding to infant crying, an important component of maternal sensitivity. Furthermore, the early maternal–child relationship may be influenced by the perinatal maternal oxytocin system, a hormone known to enhance the letdown of milk during breastfeeding (Zelkowitz

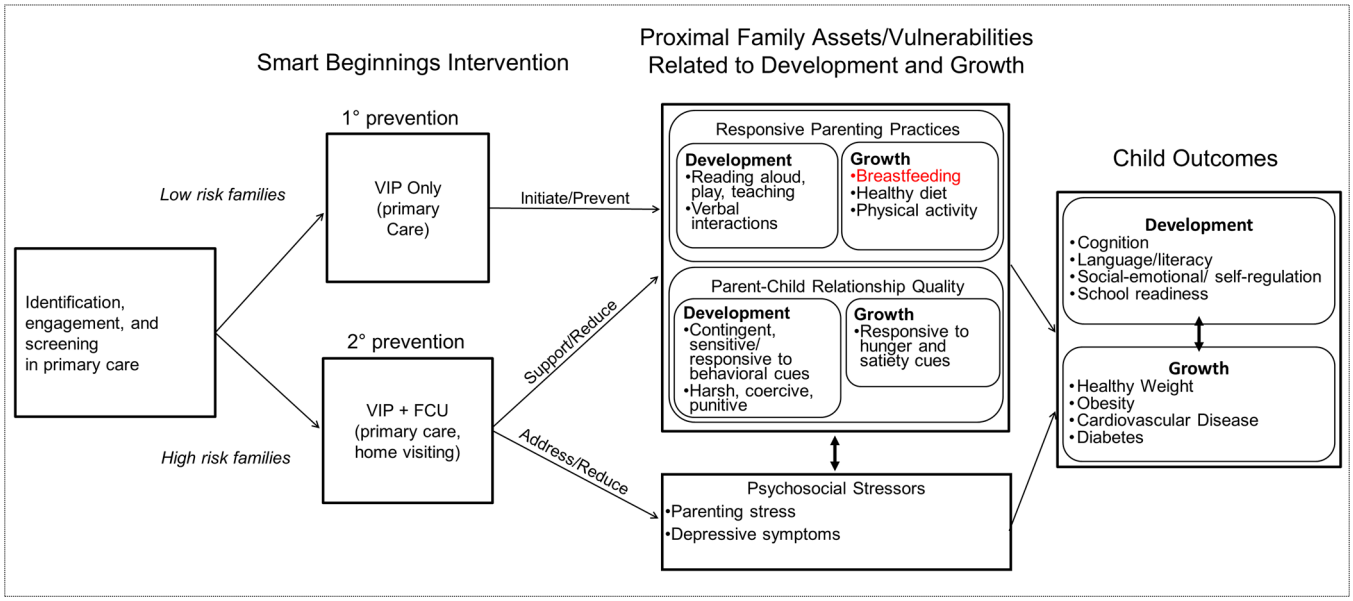

FIGURE 1 Concept diagram relating the Smart Beginnings intervention, proximal family assets/vulnerabilities, and child outcomes. Breastfeeding in red to highlight the primary outcome of these analyses.

et al., 2014). Research has found that among women who reported high levels of psychosocial stress, higher levels of oxytocin were related to fewer depressive symptoms and more sensitive maternal interactions, suggesting that the higher levels of oxytocin found during breastfeeding may buffer the adverse effects of stress on the parent–child relationship (Zelkowitz et al., 2014). Given that stress (Li et al., 2008) and depressive symptoms both before and during pregnancy have been associated with later decreased breastfeeding (Figueiredo et al., 2014; Wallenborn et al., 2018), and that responsive parenting activities such as reading aloud and play are associated with reduced stress (Cates et al., 2016) and enhanced parent–child relationships (Canfield et al., 2020), some evidence exists to support that enhanced responsive parenting practices may lead to the development of healthier breastfeeding behaviours. However, despite these linkages, few studies have directly explored these associations between responsive parenting and breastfeeding. Studying how developmental interventions such as SB that are focused on parent–child relationships and positive parenting practices could have collateral impacts on breastfeeding behaviours would add experimental evidence to illuminate the directionality of these associations.

1.6 | Present study

The primary aim of the present study is to evaluate whether random assignment to SB is positively associated with breastfeeding intensity though infant age 6 months at each intervention site, a potential collateral benefit of the intervention. Additionally, based on the differences in demographics of the sample at the two intervention sites (i.e., ethnicity/race), the present study allows us to test for differences in racial and ethnic intervention impacts on breastfeeding. Based on prior research, we hypothesised that the SB intervention would increase the rates of breastfeeding intensity—a key indicator of development and growth (see Figure 1)—at each site.

2 | METHOD

The SB project is an National Institutes of Health (NIH)-funded RCT in hospital-based primary-care clinics serving primarily families with low incomes in NYC and Pittsburgh. SB is a tiered intervention, intended to deliver universal primary prevention services to families through VIP, which began at birth and included reviewing brief video recordings of parent—child play interactions with an interventionist to reinforce strengths, with secondary services delivered to families with additional psychosocial risk factors through the FCU beginning at 6 months. Control families received pediatric primary care as usual. Notably, although SB promotes responsive parenting overall, there is not an explicit component focused on the promotion of breastfeeding in the integrated SB model. If parents ask about breastfeeding, interventionists provide referrals for standard pediatric primary care resources for guidance on optimal feeding practices, including referrals to clinic lactation consultants.

2.1 | Inclusion criteria and randomization procedures

This study was part of the single-blind, two-site RCT of SB families taking place in NYC (NYC H + H/Bellevue) and in Pittsburgh, PA (University of Pittsburgh/UPMC). Informed consent was obtained from all study participants, Institutional Review Board approval was obtained, and the study is registered on clinicaltrials. gov (NCT02459327).

There was a two-phased enrolment process with consecutive sampling. In phase one, low-income families were offered enrolment and informed consent was obtained if they met the following inclusion criteria: (1) *child*: full-term, singleton, normal birthweight without significant prenatal or perinatal medical complications, ineligible for Early Intervention, and plans to receive pediatric care at the institution; and (2) *parent*: primary caregiver/legal guardian, plans to stay in the birth city for the next 3 years, primary language English or Spanish, no known significant impairment (e.g., intellectual disability and schizophrenia) or medical complication, no plans to stay in a shelter, baby discharged to mother, and no prior participation in VIP or FCU.

Phase two occurred between 1 and 6 weeks of age in the outpatient setting. Families who continued to meet all inclusion criteria, including receipt of care at the study site, were randomized to treatment or control groups. Randomization was performed separately at each site using a random number sequence. In total, 403 families were randomized including 200 in NYC and 203 in Pittsburgh. See Figures 1 and 2 for the consolidated standards of reporting trials diagrams for the SB RCT. Furthermore, families had high levels of participation in the intervention, with 98% compliance to the randomization group (Miller et al., 2020).

2.2 | Participants

Table 1 displays the basic descriptive difference in demographics and breastfeeding behaviours by treatment and control groups within site (the unit of randomization). There were no significant differences between treatment and control groups *within* site on any demographics or breastfeeding behaviours. However, there were several notable differences between sites (as expected by design). The majority of the sample mothers in NYC were Latinx (84%), whereas Pittsburgh mothers were predominantly Black/African American (81%, $p < 0.001$). More mothers in NYC were married (32% vs. 4%, $p < 0.001$) or cohabiting (49% vs. 36%, $p < 0.05$) than in Pittsburgh, yet fewer had a high school diploma or general educational development (GED) tests (56% vs. 83%, $p < 0.001$). There were also notable site differences with regard to initial breastfeeding behaviours. Many more mothers in NYC reported initiating breastfeeding at birth compared with

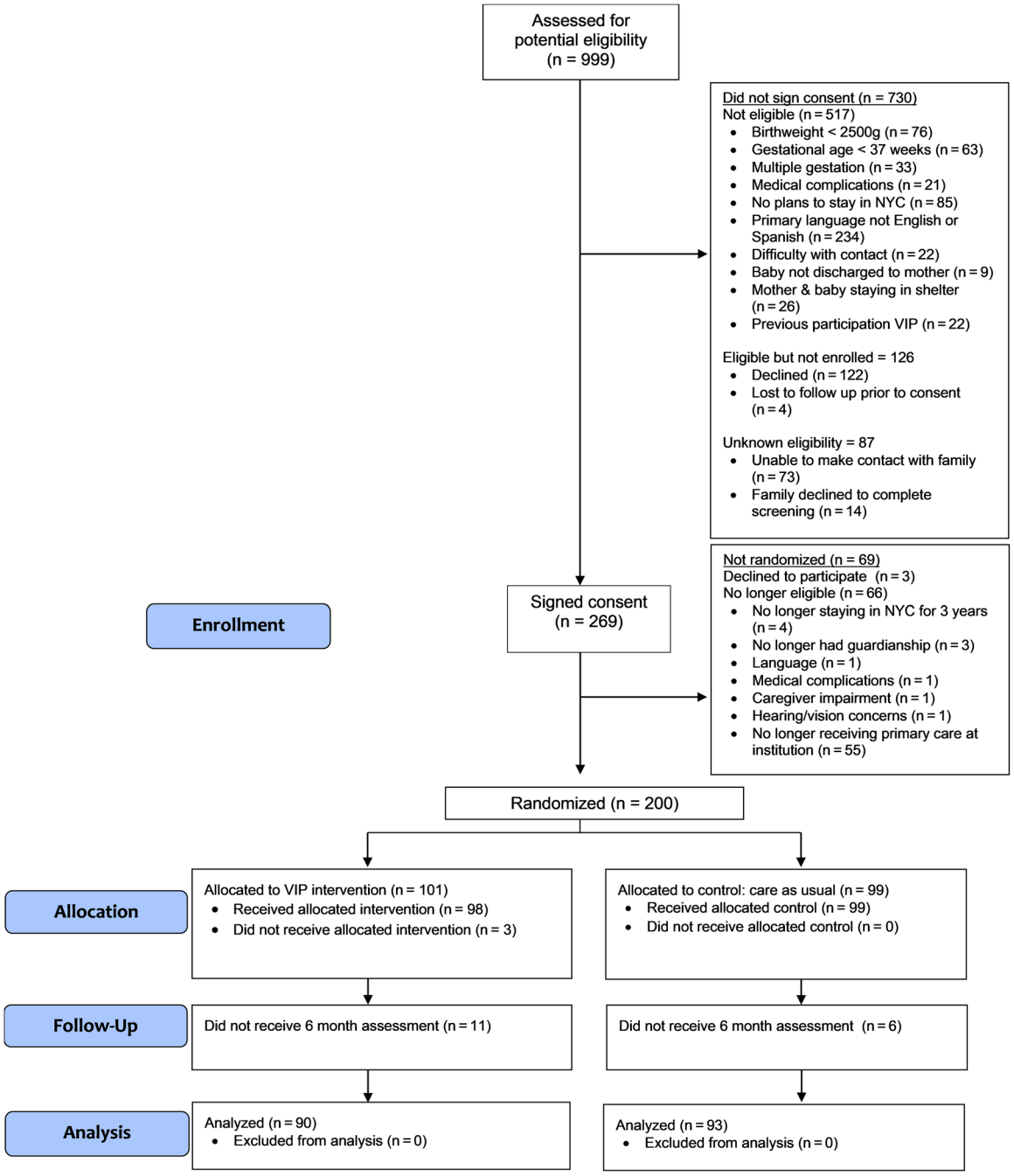

FIGURE 2 Participant enrolment and assessment in NYC

Pittsburgh mothers (96% vs. 63%, $p < 0.001$) and reported any breastfeeding intentions at birth (93% vs. 56%, $p < 0.001$), indicating differences in the base rates of breastfeeding at the two sites.

2.3 | Measures

Baseline and 6-month assessments were conducted by research assistants blinded to a randomization group and were not the same individuals delivering the SB intervention. Assessments were conducted with the target child's primary caregiver, which at 6 months was overwhelmingly the target child's mother (99.7%).

2.3.1 | Primary outcome and covariates—breastfeeding behaviours

Several breastfeeding behaviour measures were collected as part of the baseline and 6-month assessments. The primary outcome of interest was maternal breastfeeding intensity measured at the infant age of 6 months.

TABLE 1 Sample Demographics

	NYC (*N* = 200)						Pittsburgh (*N* = 203)					
	Overall		Treatment		Control		Overall		Treatment		Control	
	N	% of Sample	*N*	% of Sample	*N*	% of Sample	*N*	% of Sample	*N*	% of Sample	*N*	% of Sample
Maternal Characteristics												
Maternal age												
<20 years old	8	4	4	4	4	4	18	9	5	5	13	13
20+ years old	192	96	97	96	95	96	185	91	95	95		
Education												
Less than HS	86	44	38	38	48	49	33	16	14	14	19	18
HS diploma/GED+	110	56	61	62	49	51	170	84	86	86	84	82
Race/ethnicity												
Af. Amer./Black	15	8	11	11	4	4	164	81	79	80	85	83
Latinx	166	84	80	81	86	88	7	3	5	5	2	2
White	4	2	2	2	2	2	25	12	12	12	13	13
Marital status												
Married	62	32	32	33	30	31	9	4	6	6	3	3
Not married	133	68	66	67	67	69	194	96	94	94	100	97
Parity												
First child	70	36	37	37	33	34	66	33	30	30	36	35
Not first child	127	64	62	63	65	66	137	67	70	70	67	65
Breastfeeding behaviours												
Any breastfeeding intentions	185	94	92	92	93	96	111	55	55	55	56	54
Initiation	172	96	83	95	89	96	111	63	51	59	60	67

Two additional breastfeeding behaviour measures were also collected and used as covariates—breastfeeding initiation (collected at 6 months) and breastfeeding intentions (collected at baseline).

Intensity

At 6months, mothers were asked how the target infant was currently being fed for milk-based feeds; complementary foods or liquids were not probed as these are only first recommended for introduction at 6 months by the AAP (Meek et al., 2022). Responses ranged from 1 to 5: *exclusive infant formula* (1); *more infant formula than breast milk* (2); *about the same infant formula and breast milk* (3); *more breast milk than infant formula* (4); and *exclusive breast milk* (5). Two outcome measures were created using these initial responses: whether the infant was receiving any breast milk at 6 months (dichotomous) and whether the infant was receiving breast milk as the only milk source at 6 months (dichotomous). Providing breast milk as the only milk source was used instead of exclusive breastfeeding as data about complementary feeding were not obtained, and the WHO defines exclusively breastfeeding as providing only breast milk without any complementary foods or liquids, except vitamins (WHO, 2021).

Initiation

At 6 months, mothers were also asked if they ever breastfed the target infant as a dichotomous indicator.

Intentions

At baseline, mothers were asked how they planned to feed the target infant from *all breast* (1) to *all formula* (5). A dichotomous measure was created from initial responses indicating whether the mother planned any breastfeeding.

A complete list of survey questions on breastfeeding behaviours and answer choices are presented in Supporting Information: Appendix Table 1.

2.3.2 | Primary independent variable—random assignment to treatment condition

The primary independent variable was a random assignment to the SB intervention. In this intent-to-treat analysis, respondents randomly assigned to receive the SB intervention were denoted as *treated* (1), and those assigned to the control

condition, or routine primary care, were denoted as *control* (0) (dichotomous).

2.4 | Analysis plan

Impact analyses used an intent-to-treat (ITT) design leveraging a two-arm random assignment structure. All analyses were performed using Stata 14 (StataCorp, 2015). Logistic regressions were used to determine associations between the primary independent variable of treatment assignment and the dichotomous breastfeeding intensity outcomes of interest (any breastfeeding at 6 months and breast milk as the only milk source at 6 months), accounting for the covariates of breastfeeding intentions at birth and initiation by 6 months. Based on the differences in breastfeeding rates at 6 months at the two sites (71% at NYC vs. 16% at Pittsburgh, $p < 0.001$), potentially reflective of larger racial/ethnic differences in breastfeeding (CDC, 2018), as well as large differences in the SB demographic characteristics by site, analyses were conducted separately for NYC and Pittsburgh.

2.5 | Ethics statement

Research was conducted in accordance with prevailing ethical principles and reviewed by the Institutional Review Boards of NYU (FY2016-408), NYU Grossman School of Medicine (S14-01764), and the University of Pittsburgh (STUDY19040158). Research approval was also obtained from NYC Health+Hospitals.

3 | RESULTS

As indicated above, there were no significant differences between the treatment and control groups on baseline characteristics greater than expected by chance at either site (the unit of randomization).

3.1 | Does random assignment to SB impact breastfeeding at 6 months?

Results from the ITT analyses are presented in Table 2 and Figure 3. There were no detected treatment impacts on the likelihood of engaging in any breastfeeding at 6 months at either site (adjusted odds ratio $[AOR]_{NYC} = 0.68$, $p = 0.34$; $AOR_{PITT} = 1.06$, $p = 0.90$). Further, in NYC, no group differences were evident in the likelihood of providing breast milk as the only milk source ($AOR = 0.59$, $p = 0.12$). However, in Pittsburgh, mothers randomly assigned to the intervention were over three times as likely to provide breast milk as the only milk source compared with mothers assigned to the control condition ($AOR = 3.61$, $p = 0.04$; 15% vs. 7%, respectively). This impact held despite mothers in Pittsburgh having equally strong breastfeeding intentions at birth (55% vs. 54%; $X^2 = 0.01$, $p = 0.93$) and equal initiation of breastfeeding (59% vs. 67%; $X^2 = 1.22$, $p = 0.27$) across

TABLE 2 SB treatment impacts on breastfeeding, by site

	NYC						Pittsburgh					
	N (% of Tx sample)	*N* (% of control sample)	AOR	95% CI	*t*	*p*	*N* (% of Tx Sample)	*N* (% of control sample)	AOR	95% CI	*t*	*p*
Any breastfeeding 6 months	59 (68%)	69 (74%)	0.68	[0.31, 1.50]	−0.95	0.34	14 (16%)	14 (16%)	1.06	[0.42, 2.68]	0.13	0.90
			(0.27)						(0.50)			
Breastmilk as only milk source 6 months	28 (32%)	39 (42%)	0.59	[0.30, 1.15]	−1.55	0.12	13 (15%)	6 (7%)	3.61	[1.07, 12.13]	2.08	0.04
			(0.20)						(2.23)			

Note: Standard errors in parentheses. Models control for breastfeeding intentions at birth and initiation by 6 months.
Abbreviations: AOR, adjusted odds ratio; CI, confidence interval.

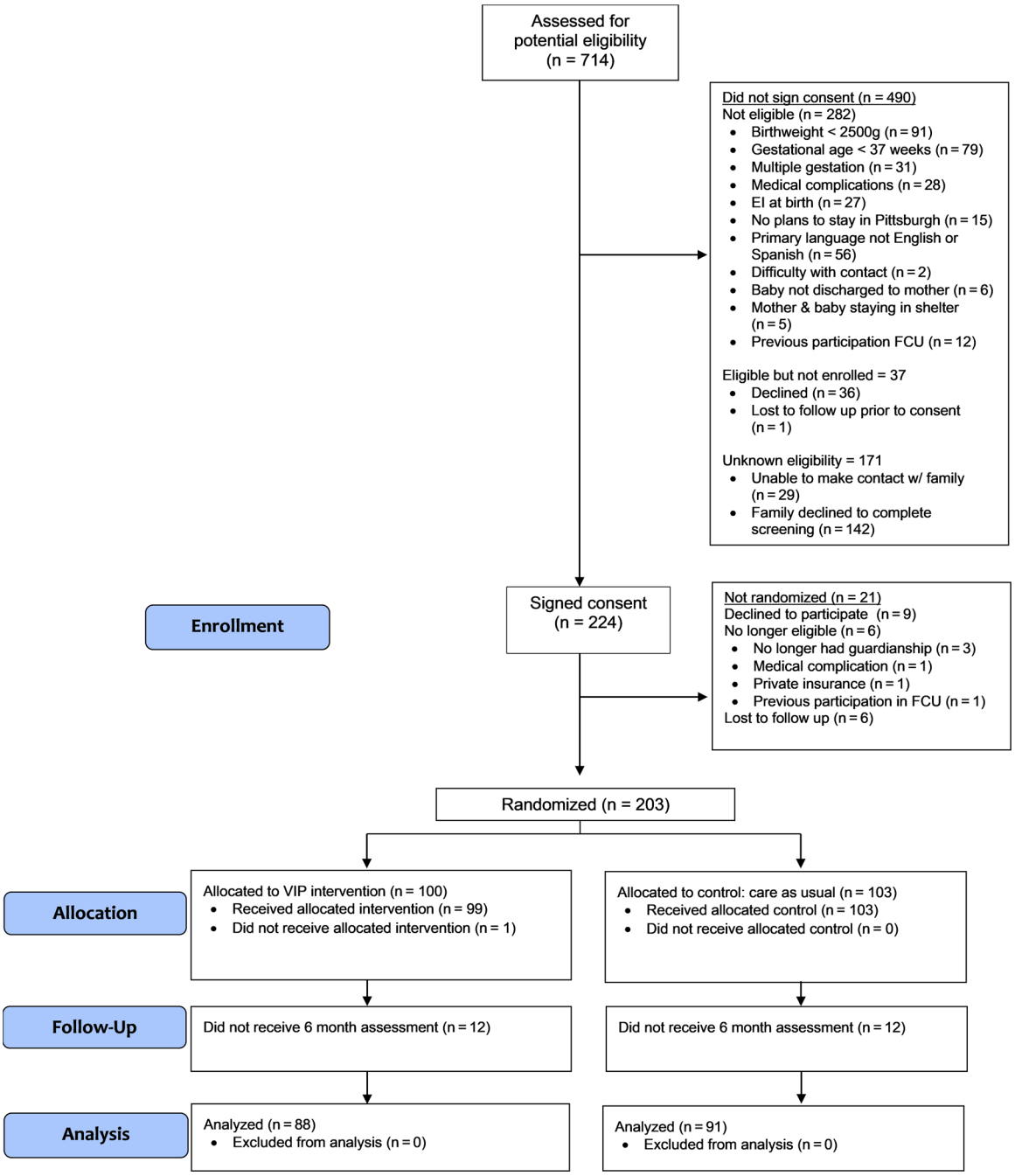

FIGURE 3 Participant enrolment and assessment in Pittsburgh

the two intervention conditions. Importantly, given the extremely high rate of compliance to randomization group assignment (98%) within both sites, we assume these ITT estimates are unbiased and do not assess their sensitivity (Figure 4).

In addition, to better understand whether these impacts were driven by the different racial/ethnic makeup of participants at each site given racial and ethnic disparities in breastfeeding rates in the United States (CDC, 2018), we explicitly tested for treatment by racial/ethnic effects on breastfeeding intensity and found a trend that the impacts at Pittsburgh were largely driven by impacts on Black/African American mothers ($p < 0.10$).

4 | DISCUSSION

We found that a two-site tiered parenting intervention targeting parent–child relationship quality to promote school readiness, increased rates of providing breast milk as the only milk source in the SB site with low initial rates of breastfeeding. We found that mothers assigned to the intervention group in Pittsburgh, serving primarily Black/African American families, had nearly three times the rate of providing breast milk as the only milk source at child age 6 months than mothers assigned to the control group. Mothers assigned to the intervention group in NYC, serving primarily Latinx

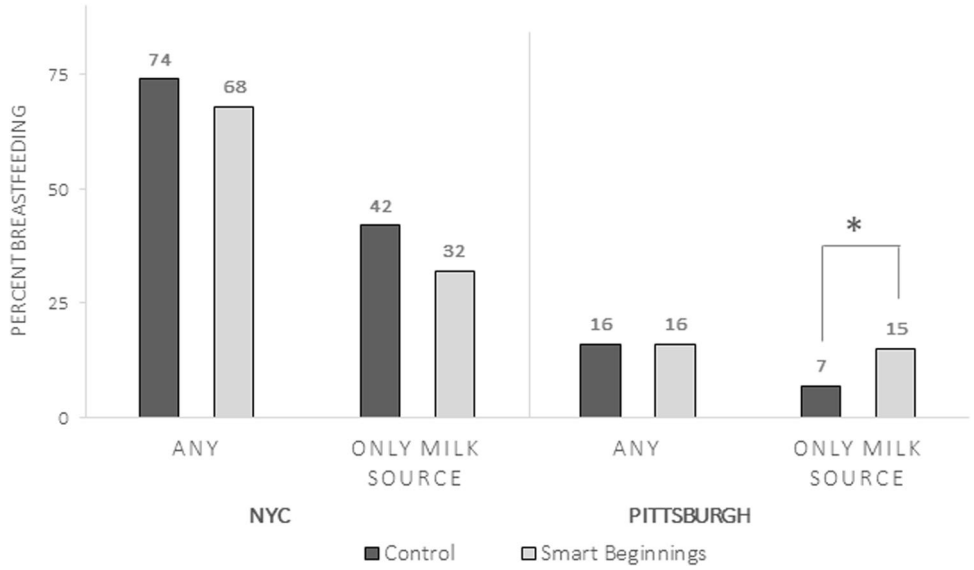

FIGURE 4 Smart Beginnings (SB) treatment impact on breastfeeding rates at 6 months

families with high initial rates of breastfeeding across both treatment conditions, however, did not show differences in rates of providing breast milk as the only milk source compared with controls.

These findings contribute to the small, but growing, literature on the potential health benefits of early learning interventions by examining the causal impacts of a school-readiness intervention on breastfeeding. A broad range of developmental preventive interventions focused on general parent–child relationships has shown impacts on feeding interactions and early child obesity without specifically targeting these outcomes (e.g., Brotman et al., 2012; Campbell et al., 2014; Gross et al., 2015; Ordway et al., 2018; Smith et al., 2015). While the pathways by which these later health changes occur are sometimes unknown, one hypothesised mechanism is that participation in a generalised positive-parenting programme may increase healthy parental feeding behaviours. For instance, in exploring the relationship between FCU participation and healthy adolescent weight, impacts were mediated through changes in maladaptive family eating styles (Smith et al., 2015). Similarly, it has been suggested that among families with low incomes utilizing Head Start for their children, mealtime climate and feeding styles may be a mechanism that leads to more unhealthy eating patterns, higher childhood weight gain, and higher rates of childhood obesity (Hughes et al., 2011). Our study extends these findings to include a key indicator of infant nutrition—breastfeeding. Importantly, there is not an explicit health promotion component to the SB intervention model, although it is possible delivery in a pediatric primary care setting and the resultant extended time spent there over and above routine primary care may tacitly promote healthy feeding behaviours.

The rationale for why impacts on providing breast milk as the only milk source were only seen in the Pittsburgh site remains unclear. This difference may be because overall base breastfeeding rates were already somewhat high in NYC; 71% of the NYC mothers reported any breastfeeding at 6 months across treatment status compared with 16% in Pittsburgh, and 37% were providing breast milk as the only milk source in NYC versus 11% in Pittsburgh. As the vast majority of mothers in NYC were Latinx (84%) and mothers in Pittsburgh were predominantly Black/African American (81%), these findings would be consistent with the broader literature on racial/ethnic disparities in breastfeeding rates (CDC, 2018).

Nonetheless, it is intriguing that the SB intervention improved rates of providing breast milk as the only milk source in the site with low initial rates of breastfeeding. It may be that SB allowed families with these low rates the confidence to bring up feeding issues during VIP sessions to get appropriate lactation support referrals. Furthermore, the FCU model allows for families to attend to potentially distressful topics (such as infant feeding) and for the parent consultant to provide available services when topics come up. Moreover, the indirect supportive evidence for responsive parent–child relationships and reductions in stress relate to increases in breastfeeding (Li et. al, 2008; Figueiredo et. al, 2014; Wallenborn et. al, 2018; Cates et al., 2016; Canfield et. al, 2020) may also be a factor as to why SB, a strengths-based, family-centred preventive intervention, may have had an impact on these rates.

4.1 | Limitations and future directions

Some study limitations should be noted. First, we were underpowered to test for mediation effects and therefore did not test whether the relationship between intervention status and breastfeeding intensity in Pittsburgh was mediated by variables known to support breastfeeding such as warm and sensitive parent–child interactions, and by those impacted by the SB intervention (Miller et al., 2022). Second, breastfeeding behaviours were based on maternal reports, which may be influenced by social desirability bias. Lastly, the study focused only on breast milk and formula

consumption and did not include other infant feeding practices such as the early introduction of complementary foods or liquids other than milk such as water or juice, which are only first recommended for introduction by the AAP at 6 months (Meek et al., 2022), though some families do introduce these earlier. Therefore, we were unable to determine whether those who were providing breast milk as the only milk source could be characterised as exclusively breastfeeding according to the WHO definition (2021).

Future work should examine how the medical home model of care can leverage limited resources for intervention delivery to address broader aspects of child health and development. Collateral benefits to additional outcomes, combined with programmatic knowledge, suggest that school readiness parenting programmes like SB may prove to be even more cost-efficient than originally conceived based on their extended impacts beyond child development. This study further adds to the growing literature that parenting interventions based on pediatric primary care may lead to synergistic effects across domains using a single intervention model (Black et al., 2015; Grantham-McGregor et al., 2014). In addition, studies like this that examine collateral benefits can continue to provide helpful information about integrated models more broadly.

Future research should also continue to study the mechanisms through which parenting programmes produce unintended outcomes in both health promotion and early learning, and assist programme implementers in adapting interventions across contexts to maximise positive outcomes (McEachern et al., 2013; Oliver et al., 2019). Studying these collateral outcomes is a crucial component of all programme evaluation efforts (Oliver et al., 2019), and especially important given ongoing efforts to scale programmes like SB within comprehensive, population-level initiatives (e.g., The Pittsburgh Study; Roby et al., 2021). As development and growth are the two most fundamental components of child well-being during these early years, finding interventions to address them both simultaneously holds great promise (Gross et al., 2021).

In summary, we found that the SB intervention improved rates of providing breast milk as the only milk source in the Pittsburgh site with low initial rates of breastfeeding. Our study contributes to the small, but growing, literature on the potential health benefits of early learning interventions and extends these findings to breastfeeding, a key indicator of infant nutrition. It further adds to the study of collateral programme benefits in adapting interventions across contexts and maximizing positive outcomes. Understanding how interventions impact parenting practices across the two most salient domains in early childhood—development and growth—is critical to address long-term economic and racial/ethnic disparities.

AUTHOR CONTRIBUTIONS

Elizabeth B. Miller, Mackenzie D. M. Whipps, and Rachel S. Gross conceptualised and designed the study, conducted statistical analyses, drafted the initial manuscript, and reviewed and revised the manuscript. Debra L. Bogen, Pamela A. Morris, Alan L. Mendelsohn, and Daniel S. Shaw conceptualised and designed the study, conducted statistical analyses, and reviewed and revised the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Deidentified primary data will be made available to interested researchers through the establishment of data sharing agreements. Consistent with NIH policy, the timeline for the release of data will be no later than the acceptance for publication of the main findings from the final data set. Data will be made available to researchers who provide a methodologically sound proposal for use in achieving the goals of the approved proposal. Proposals should be submitted to Pamela Morris (pamela.morris@nyu.edu).

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