Reading Aloud, Play, and Social-Emotional Development

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abstract

OBJECTIVES: To determine impacts on social-emotional development at school entry of a pediatric primary care intervention (Video Interaction Project [VIP]) promoting positive parenting through reading aloud and play, delivered in 2 phases: infant through toddler (VIP birth to 3 years [VIP 0–3]) and preschool-age (VIP 3 to 5 years [VIP 3–5]).

METHODS: Factorial randomized controlled trial with postpartum enrollment and random assignment to VIP 0-3, control 0 to 3 years, and a third group without school entry follow-up (Building Blocks) and 3-year second random assignment of VIP 0-3 and control 0 to 3 years to VIP 3-5 or control 3 to 5 years. In the VIP, a bilingual facilitator video recorded the parent and child reading and/or playing using provided learning materials and reviewed videos to reinforce positive interactions. Social-emotional development at 4.5 years was assessed by parent-report Behavior Assessment System for Children, Second Edition (Social Skills, Attention Problems, Hyperactivity, Aggression, Externalizing Problems).

RESULTS: VIP 0-3 and VIP 3-5 were independently associated with improved 4.5-year Behavior Assessment System for Children, Second Edition T-scores, with effect sizes (Cohen's d) ∼−0.25 to −0.30. Receipt of combined VIP 0-3 and VIP 3-5 was associated with d = −0.63 reduction in Hyperactivity (P = .001). VIP 0-3 resulted in reduced "Clinically Significant" Hyperactivity (relative risk reduction for overall sample: 69.2%; P = .03; relative risk reduction for increased psychosocial risk: 100%; P = .006). Multilevel models revealed significant VIP 0-3 linear effects and age × VIP 3-5 interactions.

CONCLUSIONS: Phase VIP 0-3 resulted in sustained impacts on behavior problems 1.5 years after program completion. VIP 3-5 had additional, independent impacts. With our findings, we support the use of pediatric primary care to promote reading aloud and play from birth to 5 years, and the potential for such programs to enhance social-emotional development.

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Dr Mendelsohn conceptualized and designed the study, conducted statistical analyses, drafted the initial manuscript, and reviewed and revised the manuscript; Drs Cates, Weisleder, and Berkule Johnson conceptualized and designed the study, designed the data collection instruments, coordinated and supervised data collection, and critically reviewed the manuscript; Drs Seery and Canfield conducted statistical analyses and critically reviewed the manuscript; Drs Dreyer and Huberman conceptualized and designed the study and critically reviewed the manuscript; and all authors approved the final manuscript as submitted.

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WHAT'S KNOWN ON THIS SUBJECT: Pediatric primary care represents a population-scalable platform for providing effective, low-cost interventions to prevent poverty-related disparities by promoting positive parenting. A recent study revealed that the Video Interaction Project enhanced infant through toddler social-emotional competencies critical for education and health.

WHAT THIS STUDY ADDS: In a randomized controlled trial of the Video Interaction Project, we demonstrated that promoting parent and child reading aloud and play reduced hyperactivity at school entry, with sustained impacts 1.5 years after completion and increased impacts with continued intervention. With our findings, we support pediatric preventive intervention from birth to 5 years.

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Poverty-related disparities in social-emotional development emerge during early childhood and represent a barrier to learning after school entry.[1–3] The pediatric primary care platform can deliver low-cost, low-intensity interventions for population-level prevention of disparities.[4–6] Positive parenting strategies are linked with improved social-emotional development and are a potential focus of such interventions.[7–9]

There are several important research gaps. First, there has been a focus on families with additional psychosocial risks and already emergent problems[8,10] and less study of "primary" prevention before problem onset. Second, although developmental considerations support intervening from infancy through preschool,[11] there has been limited study of additive and/or differential impacts of infant through toddler and preschool interventions.[12] Third, although research has revealed sustained impacts of infant through toddler primary prevention beyond program completion for home visiting (eg, Nurse Family Partnership[13]), there has been more limited study of sustained impacts for low-cost, low-intensity primary care programs.[14] Fourth, although programs focused on child behavior (eg, The Incredible Years[8]) demonstrate impacts on social-emotional development, there has been limited study of social-emotional impacts of primary care programs promoting reading aloud and play; this is important given wide dissemination of such programs (eg, Reach Out and Read [ROR][15–18]).

We sought to address these gaps through the Bellevue Project for Early Language and Literacy Success, a factorial randomized controlled trial (RCT) of the Video Interaction Project (VIP), a pediatric primary care intervention that builds on ROR and promotes positive parenting through reading aloud, play, and daily routines.[19–22] The VIP has 2 components: (1) infant through toddler (VIP birth to 3 years [VIP 0-3]) and (2) preschool-age (VIP 3 to 5 years [VIP 3-5]). We have previously shown that VIP 0-3 enhanced 3-year social-emotional development (at program's end).[23]

We had 3 aims in which we sought to determine the following: (1) if the infant-toddler component (VIP 0–3) had sustained impacts on children's social-emotional development at 4.5 years, 1.5 years after program completion; (2) if the preschool-age component (VIP 3–5) had early, independent impacts at 4.5-year follow-up; and (3) if there were additive impacts and/or evidence of synergy related to receiving a larger intervention "dose" (infant through toddler and preschool together). We hypothesized that VIP 0-3 and VIP 3-5 would have additive, independent effects on social-emotional development at 4.5 years.

METHODS

Study Design

We performed a factorial, single-blind RCT at an urban public hospital serving low-income families (Bellevue Hospital Center [BHC]), with enrollment and first random assignment during the postpartum period, second random assignment at age 3 years, and 5 assessments through 4.5 years. The trial was approved by the New York University School of Medicine Institutional Review Board and BHC Research Review Committee and was registered with clinicaltrials.gov (NCT00212576). Separate informed consent was obtained for enrollment and first random assignment and for second random assignment.

Participants

Consecutive mother and infant dyads meeting inclusion criteria and providing informed consent were enrolled and randomly assigned postpartum from November 2005 through October 2008. Inclusion criteria were as follows: planned pediatric care at BHC, full-term, no significant medical complications or early intervention eligibility at birth, and mother primary caregiver was 18 years or older, English- or Spanish-speaking, with a working telephone or pager. Consent for the second random assignment took place at ~3 years by research assistants masked to group assignment.

Random Assignment

There were 2 phases of random assignment. Dyads were randomly assigned postpartum to VIP 0-3, control 0 to 3 years, or a third group (Building Blocks [BB])[19] by using a random number generated by the project director using Microsoft Excel (Microsoft Corp, Redmond, WA). The second random assignment took place by using the same methodology at the time of the 3-year assessment. All families assigned at postpartum random assignment to VIP 0-3 or control 0 to 3 years were eligible at 3 years for second random assignment to VIP 3-5 or control 3 to 5 years. Families assigned to BB received no follow-up beyond 24 months, did not participate in the 3-year random assignment or 3- and 4.5-year assessments, and did not have data for the present analyses. Group assignments were concealed from staff and study participants until consent for each random assignment was completed.

VIP

1. VIP 0-3: As previously described, VIP 0-3 was provided by a bilingual facilitator over 15 possible 1-on-1 30-minute sessions from 2 weeks to 3 years.[19] Parent and child dyads were video recorded during ~5 minutes of play or shared reading by using a developmentally appropriate learning material (toy or book). Videos were

immediately reviewed with the parent to identify and reinforce responsive interactions and promote self-reflection. Age-specific pamphlets were used to provide suggestions for positive parenting and opportunities for parents to describe their observations and develop goals for interacting and were taken home together with videos. After a 3-year implementation, VIP 0-3's cost is estimated at $175 to $200 per child per year, including staff, equipment, supplies, rent, and utilities, with 1 interventionist providing the VIP for ~400 to 500 families.

2. VIP 3-5: VIP 3-5[21] took place during 9 30- to 45-minute sessions from 3 to 5 years with the same structure as VIP 0-3 along with enhancements designed to promote interactions in the context of rapidly emerging developmental capacities during the preschool period. VIP 3-5 was developed in consultation with preschool education experts who suggested integration of strategies from research-based curricula,[24–26] including the following: (1) building sessions around themes (eg, grocery store, birthday party); (2) video recording both story book reading and play, with play planned on the basis of the story; (3) integration of writing within play (eg, shopping list, party invitations); and (4) focusing on characters' feelings.

Control 0 to 3 years and control 3 to 5 years families received standard pediatric care during the birth- to 3-year and the 3- to 5-year periods, respectively, including recommended anticipatory guidance and monitoring. All groups received ROR.

Measures

Bilingual research assistants masked to group assignment performed assessments.

Sociodemographic Characteristics

As previously described,[19,23] we assessed baseline sociodemographic characteristics and socioeconomic status (SES; Hollingshead 4 Factor Index[27]). Maternal literacy was assessed at 6 months in the mother's preferred language by using the Woodcock-Johnson III and/or the Woodcock and M uñoz-Sandoval[28] Batería III Tests of Achievement, Letter-Word Identification Test; for families who had not received the literacy assessment, educational level was used as a proxy.[23] As in previous studies, mothers were categorized as having increased social risk if they had 1 or more of the following: homelessness, being a victim of violence, involvement with child protection, financial difficulties, food insecurity, smoking or alcohol use during pregnancy, or previous mental illness, including depression.

Dependent Variables

At 3 and 4.5 years, we assessed children's social-emotional development on the basis of parent reports using 4 subscales from the Parent Rating Scales of the Behavior Assessment System for Children, Second Edition (BASC-2)[29] (Social Skills, Attention Problems, Hyperactivity, and Aggression) and an Externalizing Problems composite (Hyperactivity and Aggression). The BASC-2 has been normed in English and Spanish. T-scores (mean = 50; SD = 10) were calculated. Recommended cut points were used to dichotomize scores as "Clinically At-Risk" (T-score ≥60, 1 SD above the mean) and "Clinically Significant" (T-score ≥70, 2 SD above the mean) for Attention Problems, Hyperactivity, Aggression, and Externalizing; Social Skills were categorized as Clinically At-Risk for a T-score ≤40 (1 SD below the mean).

Analytic Sample

The analytic sample for aim 1 (sustained VIP 0–3 impacts) consisted of 275 families randomly assigned postpartum to VIP 0-3 or control 0 to 3 years who had the 4.5-year assessment. The analytic sample for aim 2 (early VIP 3–5 impacts) and aim 3 (additive and/or synergistic impacts) consisted of 252 families randomly assigned a second time at age 3 years who had the 4.5-year assessment. Twenty-three families who were randomly assigned postpartum were not randomly assigned a second time because of either missing the 3-year assessment (n = 22) or not consenting for second random assignment (n = 1) but nonetheless received the 4.5-year assessment because the original enrollment consent included follow-up beyond age 3 years. These 22 families were within the random assignment protocol for aim 1 and were included in the aim 1 analytic sample but were outside the random assignment protocol for aims 2 and 3 and therefore were not included in the aim 2 and aim 3 analytic samples.

Statistical Analysis

Power analyses, previously described for postpartum enrollment, were also performed for the current sample and revealed that 275 dyads would provide 80% power to detect 0.35 SD differences with 2-tailed $\alpha = .05$. Statistical analyses were performed on the basis of intent to treat for each aim. χ^2 and t tests and/or analysis of variance tests were used to compare families contributing data at 4.5 years with those who did not and also to compare across groups for sociodemographics and behavior scores at age 3 years after phase VIP 0-3 completion and before phase VIP 3-5 initiation. For aim 1 (sustained VIP 0–3 impacts), we compared VIP 0-3 and control 0 to 3 years children for mean behavior scores and proportions meeting clinical thresholds using multiple linear and logistic regressions, respectively, that adjusted for VIP 3-5 random assignment; comparisons of cells with 0% present were based on

Fisher's exact test. For aim 2 (early VIP 3–5 impacts), we similarly compared VIP 3-5 and control 3 to 5 years children with adjustment for VIP 0-3 random assignment. For aims 1 and 2, Cohen's d (mean difference and population SD), relative risk reduction (RRR), absolute risk reduction (ARR), number needed to treat (NNT; calculated as 1/ARR), and 95% confidence intervals (CIs) were calculated. Subgroup analyses were performed for families at increased psychosocial risk, given greater impacts on 3-year behavior.[23] For aim 3 (additive and synergistic impacts), we performed cross-sectional analyses as follows: (1) compared mean 4.5-year behavior scores by using linear regressions in which the predictor variable was the number of VIP doses (0–2), and (2) estimated effect sizes by using multiple linear regressions dummy coded separately for receipt of VIP "double dose" (combined VIP 0–3 and VIP 3–5) or "single dose" (either VIP 0–3 or VIP 3–5) and compared with receipt of no VIP (control 0–3 years and control 3–5 years) as the reference group. Finally, we analyzed trajectories from 3 to 4.5 years using multilevel models (MLMs) with Stata/SE 14 (StataCorp, College Station, TX). MLM analyses allowed us to determine sustained impacts of VIP 0-3 (linear coefficient for VIP 0–3) and in separate models, impacts of VIP 3-5 (VIP 3–5 × age interaction), while accounting for repeated measures and random slopes; additional models allowed us to test for potential synergy (ie, additional increase in impact due to inclusion of both components) through inclusion of a double interaction term (VIP 0–3 × VIP 3–5 × age). Multiple comparisons were addressed through the Benjamini and Hochberg[30] procedure by using a false discovery rate of 10% (ie, 1 in 10 statistically significant tests expected to be false positive)[31]; application of this approach yielded equivalent findings.

RESULTS

Study Sample

Of 675 families enrolled postpartum, 450 were randomly assigned to VIP 0-3 and control 0 to 3 years, and 275 (61.1%) completed the 4.5-year assessment and were included in aim 1 analyses (Fig 1). Two hundred and ninety-six of the 450 families (65.8%) were randomly assigned a second time at 3 years, of whom 252 families (85.1% of second random assignment) completed the 4.5-year assessment and were included in aims 2 and 3 analyses.

Participants in both the aim 1 and aim 2 and aim 3 samples were comparable across study conditions for all baseline characteristics (Table 1), although VIP 0-3 families had somewhat lower literacy ($P < .10$), and VIP 3-5 families had lower maternal age ($P < .05$). The 275 families included in 1 or more analytic samples were similar to nonparticipants for maternal age, marital status, social risk, and firstborn child; however, in the analytic samples, there were more who had lower education ($P < .001$), literacy ($P < .05$), and SES ($P < .01$) and were more likely Hispanic and/or Latino ($P < .001$), immigrants ($P < .001$), and Spanish-speaking ($P < .001$), with somewhat more female children ($P < .10$). Among these families, a median of 10 out of 15 VIP 0 -3 visits were attended, and a median of 4 out of 6 possible VIP 3-5 visits before 4.5 years were attended.

Analyses of Aim 1: Sustained Impacts of VIP 0-3

VIP 0-3 was associated with sustained reductions in Attention Problems (d = −0.25), Hyperactivity (d = −0.31), and Externalizing (d = −0.24) at age 4.5 years, 1.5 years after completion of the program (Table 2), with 59.6% RRR in meeting the Behavior Assessment System for Children (BASC) Externalizing Clinically At-Risk criterion for the overall sample and an 80.2% RRR for those with increased psychosocial risk (Table 3). In addition, VIP 0-3 was associated with a reduction in meeting the BASC Hyperactivity Clinically Significant criterion for the overall sample (2.8% [VIP 0–3] versus 9.1% [control 0–3 years]; RRR: 69.2%; 95% CI: 7.0 to 89.8; $P = .03$) and for those at increased psychosocial risk (0% [VIP 0–3] versus 15.6% [control 0–3 years]; RRR: 100%; 95% CI not defined because of 0% proportion; $P = .006$ by Fisher's exact test). The ARR for Clinically Significant Hyperactivity was 6.3% for the overall sample and 15.8% for those at increased psychosocial risk, respectively, corresponding to NNTs of ∼16 (95% CI: 8 to 156) and 6 (95% CI: 3 to 26), respectively. No significant reductions were found for any of the other scales for the clinical criteria. No differences were found for Social Skills.

Aim 2 Analyses: Early Impacts of VIP 3-5

VIP 3-5 was associated with early reductions (Table 4) for Aggression (d = −0.22) and Externalizing Problems (d = −0.26) and marginally for Hyperactivity (d = −0.26). There was a 60.7% RRR in meeting the BASC Externalizing Clinically At-Risk criterion for the overall sample and a 72.3% reduction (not significant) for those with increased psychosocial risk (Table 5). No differences were found for Social Skills or Attention Problems.

Aim 3 Analyses: Dose and Trajectory Impacts

Each dose (ie, receipt of either VIP 0–3 or VIP 3–5) was associated with reductions in Attention Problems, Hyperactivity, Aggression, and Externalizing Problems, with d's ranging from −0.18 to −0.32 per dose received (Table 6). Receipt of double dose (ie, both VIP 0–3 and VIP 3–5) was associated with reductions in each of these domains,

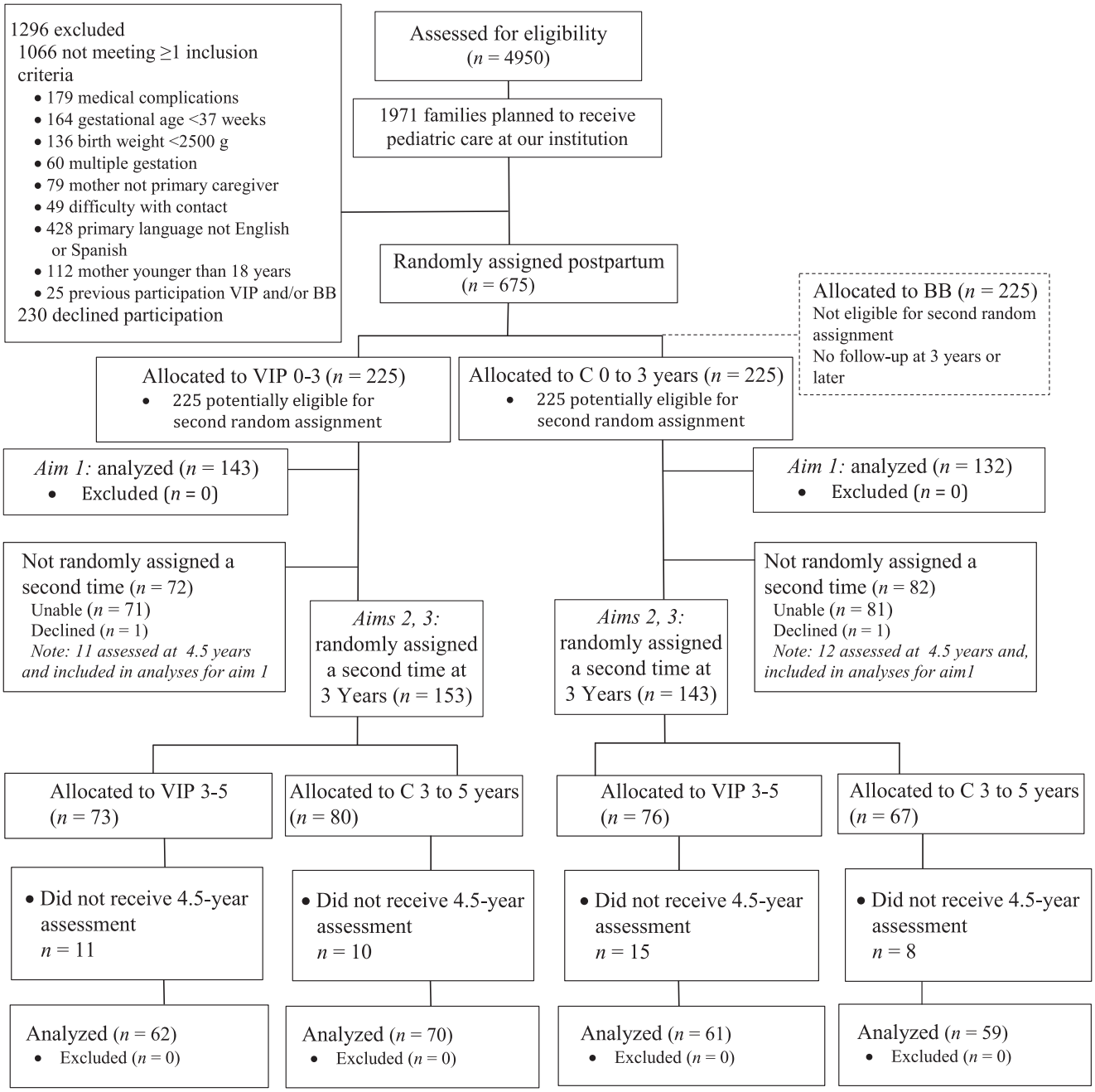

FIGURE 1
Participant flowchart. C, control.

with d = −0.63 for Hyperactivity and d = −0.54 for Externalizing Problems. MLMs of trajectories for Attention Problems, Hyperactivity, Aggression, and Externalizing (Table 7, Fig 2) revealed significant linear coefficients for VIP 0-3 across the age range but no significant age × VIP 0-3 interactions (latter not shown), indicating that differences in VIP 0-3 at 3 years were sustained through 4.5 years. In contrast, trajectory models revealed significant age × VIP 3-5 interactions for Hyperactivity, Aggression, and Externalizing but no significant linear coefficients for VIP 3-5, indicating increasing impacts for VIP 3-5 after second random assignment. Furthermore, a nonsignificant trend was seen in which VIP 0-3 and VIP 3-5 each potentiated impacts of the other on Attention Problems, as indicated by the age × VIP 0-3 × VIP 3-5 interaction (Fig 2B; $P = .06$).

DISCUSSION

We found that promotion of positive parenting activities such as reading

TABLE 1 Demographic Characteristics at Baseline (Postpartum) of Families in the Analytic Sample for Each Aim

	By VIP 0–3 Status (Aim 1)			By VIP 3–5 Status (Aim 2)			By Combined VIP 0–3 and VIP 3–5 Status (Aim 3)				
	Control 0–3 Years (*n* = 132)	VIP 0–3 (*n* = 143)	*P*[a]	Control 3–5 Years (*n* = 129)	VIP 3–5 (*n* = 123)	*P*[a]	Control 0–3 Years + Control 3–5 Years (*n* = 59)	VIP 0–3 + Control 3–5 Years (*n* = 70)	Control 0–3 Years + VIP 3–5 (*n* = 61)	VIP 0–3 + VIP 3–5 (*n* = 62)	*P*[a]
Family low SES[b]	91%	93%	.65	93%	92%	.99	93%	93%	93%	92%	.99
Family increased psychosocial risk[c]	29%	34%	.44	32%	30%	.79	36%	29%	23%	37%	.30
Mother not high school graduate	61%	67%	.31	61%	67%	.36	59%	63%	62%	73%	.45
Mother with low literacy (less than ninth grade)	25%	36%	.07	33%	28%	.41	22%	41%	25%	31%	.07
Mother married or partnered	83%	83%	.99	84%	85%	.73	83%	84%	84%	87%	.93
Mother age <21 y	9%	8%	.99	5%	13%	.048	7%	4%	13%	13%	.20
Mother Hispanic	96%	94%	.79	93%	97%	.26	93%	93%	97%	97%	.62
Mother born outside United States	88%	94%	.10	93%	91%	.64	92%	94%	85%	97%	.10
Mother primary language Spanish	86%	89%	.47	86%	92%	.16	85%	87%	88%	95%	.29
Mean child age in mo (SD)	57.8 (4.3)	58.0 (4.8)	.77	57.2 (3.7)	57.9 (4.2)	.14	56.9 (3.5)	57.4 (3.9)	57.9 (4.1)	57.9 (4.2)	.43
Firstborn child	36%	41%	.47	40%	39%	.99	32%	46%	39%	39%	.48
Female child	51%	57%	.28	56%	52%	.61	53%	59%	48%	57%	.61

[a] *P* value based on χ^2 tests for comparisons of proportions and *t* tests and/or analysis of variance tests for comparisons of means.

[b] Low SES was defined as a Hollingshead 4 Factor Index of 4 or 5.

[c] Increased psychosocial risk was defined as having 1 or more of the following: homelessness, being a victim of violence, having involvement with child protection, financial difficulties, food insecurity, smoking or alcohol use during pregnancy, or previous mental illness, including depression.

aloud, play, and talking resulted in enhanced social-emotional development for children in low-income families. VIP 0-3 (infant through toddler) resulted in sustained impacts on Externalizing Behavior and Attention Problems 1.5 years after program completion. VIP 3-5 (preschool period) resulted in additional, independent impacts, with some evidence of synergy for Attention Problems in which impacts were seen only for children participating in both components.

Effect sizes per dose of VIP (up to 0.32) were comparable to many home visiting programs, whereas those for double dose (up to 0.63) were even greater.[32,33] Notably, these impacts were found for a primary care–based intervention costing ~1/5 to 1/25 of that of home visiting; however, additional study across multiple sites and diverse populations will be needed to determine if impacts are maintained. Large reductions in risk together with relatively low NNTs (NNT = 15 and 6 for Clinically Significant Hyperactivity for the overall sample and highest risk families, respectively) suggest potential for substantial benefit to cost ratio, given high costs related to education and health care associated with clinical range disruptive behaviors[34,35] and low cost for VIP 0-3.

With these analyses, we extend previous research and can inform policies seeking prevention of poverty-related disparities. In demonstrating that primary care programs promoting reading aloud and play can impact social-emotional development at school entry, we build on our previous work in which we documented 3-year impacts at VIP 0-3's conclusion and on evidence linking these activities to enhanced parent and child relationships.[36] With our current findings, we provide not only direct support for the VIP as the program under study but also implicit support for primary care

TABLE 2 Aim 1 Analyses: Sustained Impacts of Completed VIP 0–3 on Mean (SD) BASC-2 T-scores at 4.5 Years (1.5 Years After VIP 0–3 Program Completion)

BASC-2 Composite-Scale	Control 0–3 Years (n = 132), Mean (SD)	VIP 0–3 (n = 143), Mean (SD)	Effect Size (95% CI)[a]	P[b]
Social Skills[c]	51.7 (10.2)	52.3 (10.8)	0.07 (−0.19 to 0.32)	.61
Attention Problems	49.2 (9.2)	46.7 (9.3)	−0.25 (−0.47 to −0.03)	.03
Hyperactivity	53.2 (11.4)	50.2 (10.1)	−0.31 (−0.56 to −0.06)	.02
Aggression	44.7 (6.9)	43.5 (7.2)	−0.13 (−0.30 to 0.04)	.12
Externalizing Problems	48.8 (8.9)	46.4 (8.4)	−0.24 (−0.45 to −0.04)	.02

[a] Difference between groups in SD units (Cohen's d).
[b] P value was based on multiple linear regression adjusted for second random assignment group.
[c] Higher T-scores indicate better outcomes for Social Skills and worse outcomes for other subscales.

TABLE 3 Aim 1 Analyses: Sustained Impacts of Completed VIP 0–3 on Frequency of BASC-2 Scores in Clinically At-Risk Range at 4.5 Years (1.5 Years After VIP 0–3 Program Completion)

BASC-2 Composite-Scale	Entire Sample				Increased Psychosocial Risk			
	Control 0–3 Years (n = 132), %	VIP 0–3 (n = 143), %	RRR % (95% CI)	P[a]	Control 0–3 Years (n = 38), %	VIP 0–3 (n = 48), %	RRR % (95% CI)	P[a]
Social Skills	13.6	11.2	N/A	.53	10.5	8.3	N/A	.76
Attention Problems	20.5	13.3	35.0 (−11.1 to 62.0)	.11	15.8	12.5	N/A	.77
Hyperactivity	27.3	18.2	33.3 (−4.1 to 57.3)	.07	36.8	18.8	49.1 (−4.7 to 75.3)	.06
Aggression	1.5	4.9	N/A	.15	2.6	4.2	N/A	.58
Externalizing Problems	12.1	4.9	59.6 (4.9 to 82.8)	.03	21.2	4.2	80.2 (12.2 to 95.5)	.04

N/A, not applicable.
[a] P value was based on multiple logistic regression adjusted for second random assignment group.

TABLE 4 Aim 2 Analyses: Early Impacts of VIP 3–5 on Mean (SD) BASC-2 T-scores at 4.5 Years

BASC-2 Composite-Scale	Control 3–5 Years (n = 129), Mean (SD)	VIP 3–5 (n = 123), Mean (SD)	Effect Size (95% CI)[a]	P[b]
Social Skills[c]	51.6 (10.8)	52.2 (10.1)	0.06 (−0.20 to 0.32)	.48
Attention Problems	48.3 (9.4)	47.4 (9.0)	−0.10 (−0.32 to 0.13)	.41
Hyperactivity	52.6 (10.9)	50.2 (10.2)	−0.26 (−0.52 to 0.01)	.05
Aggression	45.1 (8.0)	43.0 (5.9)	−0.22 (−0.40 to −0.05)	.01
Externalizing Problems	48.7 (9.2)	46.2 (7.7)	−0.26 (−0.47 to −0.05)	.01

[a] Difference between groups in SD units (Cohen's d).
[b] P value was based on multiple linear regression adjusted for baseline random assignment group.
[c] Higher T-scores indicate better outcomes for Social Skills and worse outcomes for other subscales.

TABLE 5 Aim 2 Analyses: Early Impacts of VIP 3–5 on Frequency of BASC-2 Scores in Clinically At-Risk Range at 4.5 Years

BASC-2 Composite-Scale	Entire Sample				Increased Psychosocial Risk			
	Control 3–5 Years (n = 129), %	VIP 3–5 (n = 123), %	RRR %[a] (95% CI)	P[b]	Control 0–3 Years (n = 41), %	VIP 0–3 (n = 37), %	RRR %[a] (95% CI)	P[b]
Social Skills	14.0	11.4	N/A	.52	9.8	8.1	N/A	.99
Attention Problems	16.3	15.4	N/A	.80	12.2	8.1	N/A	.65
Hyperactivity	26.4	18.7	29.1 (−13.3 to 55.6)	.13	26.8	27.0	N/A	.78
Aggression	5.4	0.8	85.0 (−20.0 to 98.1)	.08	7.3	0.0	100 (ND[c])	.24[c]
Externalizing Composite	12.4	4.9	60.7 (2.8 to 84.1)	.03	19.5	5.4	72.3 (−22.2 to 93.7)	.12

N/A, not applicable; ND, not defined.
[a] RRRs not calculated for $P \geq .15$; 95% CI not defined for RRR 100%.
[b] P value was based on multiple logistic regression adjusted for baseline random assignment group except as indicated.
[c] Ninety-five percent CI for RRR and P value for logistic regression not estimated because of prediction of category with 0% present; P value was based on Fisher's exact test.

TABLE 6 Aim 3 Analyses: Impact of VIP Dose on Mean (SD) BASC-2 T-Scores at 4.5 Years

BASC-2 Composite-Scale	Both Control 0–3 Years and Control 3–5 Years (n = 59), Mean (SD)	VIP 0–3 Only (n = 70), Mean (SD)	VIP 3–5 Only (n = 61), Mean (SD)	Both VIP 0–3 and VIP 3–5 (n = 62), Mean (SD)	Effect Size (95% CI) per Dose[a]	Effect Size (95% CI) for Double Dose[b]	P[c]
Social Skills[d]	51.2 (10.0)	52.0 (11.6)	51.6 (10.1)	52.7 (10.1)	0.08 (−0.11 to 0.26)	0.15 (−0.22 to 0.53)	.42
Attention Problems	49.5 (8.7)	47.2 (9.8)	49.2 (9.6)	45.7 (8.1)	−0.19 (−0.35 to −0.03)	−0.38 (−0.71 to −0.05)	.02
Hyperactivity	54.7 (11.4)	50.9 (10.2)	52.1 (11.4)	48.4 (8.6)	−0.32 (−0.50 to −0.13)	−0.63 (−1.0 to −0.26)	.001
Aggression	46.0 (8.2)	44.4 (7.8)	43.5 (5.6)	42.4 (6.1)	−0.18 (−0.31 to −0.06)	−0.36 (−0.61 to −0.11)	.005
Externalizing Problems	50.3 (9.6)	47.3 (8.8)	47.5 (8.4)	44.9 (6.9)	−0.27 (−0.42 to −0.12)	−0.54 (−0.85 to −0.24)	<.001

[a] Effect size represents average additive value of a single dose increment (ie, receipt of either VIP 0–3 or VIP 3–5 compared with receipt of neither or receipt of both compared with receipt of either) in SD units (Cohen's d) on the basis of multiple linear regression, including linear term for number of possible doses (0, 1, or 2).
[b] Effect size for receipt of both VIP 0–3 and VIP 3–5 (double dose) compared with receipt of neither, in SD units (Cohen's d), on the basis of multiple linear regression, with single and double dose dummy coded.
[c] P values were based on multiple regression analyses and Eq for estimates of increment per dose and of estimates of double dose.
[d] Higher T-scores indicate better outcomes for Social Skills and worse outcomes for other subscales.

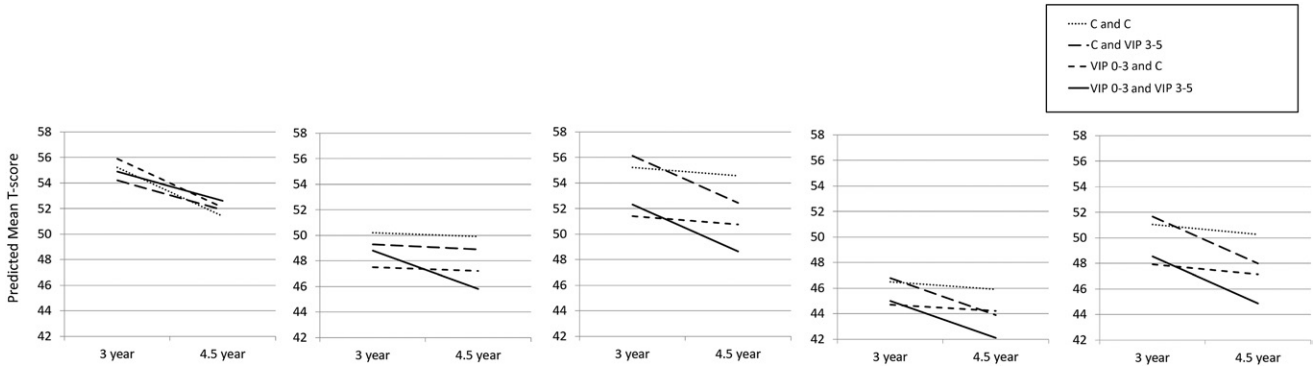

FIGURE 2
Trajectories of mean BASC-2 scores for (A) Social Skills, (B) Attention Problems, (C) Hyperactivity, (D) Aggression, and (E) Externalizing Problems from 3 to 4.5 years for children randomly assigned to each combination of VIP group and control group; the y-axis displays the predicted values based on MLMs. C, control.

programs more broadly seeking to promote these activities (eg, ROR). In demonstrating additive impacts of infant through toddler and preschool age intervention, our findings converge with a factorial RCT of the Play and Learning Strategies home visiting program, which found additive impacts resulting from extension of an infant through toddler parenting intervention through the late toddler to early preschool period.[12] In our current findings, we support the use of ongoing intervention from birth to school entry in primary care. In demonstrating impacts in a low-income sample, we build on studies of ROR and Healthy Steps in which impacts in similar populations were demonstrated.[14,37–42] With our current findings, we support a role for pediatric health care for location of universal programs seeking primary prevention before emergence of child, parent and child, and/or family challenges, in addition to secondary and tertiary prevention programs providing screening and referral for services (eg, Healthy Steps Montefiore model,[42] Help Me Grow,[10] Assuring Better Child Development[43]).

This study had a number of strengths, including the following: (1) a factorial RCT, which is a strong design for estimating independent and additive effects; (2) high follow-up of families randomly assigned a second time at 3 years (85.2%); and (3) consistency across cross-sectional and trajectory analyses. There were also important limitations. First, attrition resulted in analytic samples comprising greater proportions of Hispanic and/or Latino immigrants with lower SES, and it is possible that less-engaged families could have experienced differences in program impact. Second, assessments were conducted by parent report, which can differ from report by other observers such as teachers and be susceptible to response bias; however, the primary focus of the VIP on reading aloud and play may have reduced socially desirable responses. Third, clinical-level Hyperactivity and/or Externalizing Behaviors on the BASC do not necessarily indicate a diagnosis of attention-deficit/hyperactivity disorder, and clinical assessments were not available for participating families.

CONCLUSIONS

In this study, we provide strong support for the use of pediatric primary care to promote positive parenting activities such as reading aloud and play and the potential for

TABLE 7 Aim 3 Analyses: MLMs of Trajectories From 3 to 4.5 Years (n = 252)

BASC-2 Composite-Scale	Linear Effect (95% CI) for VIP 0–3[a]	P[b]	Linear Effect (95% CI) for VIP 3–5[a]	P[b]	Interaction Effect (95% CI) Age × VIP 3–5[c]	P[b]	Interaction Effect (95% CI) Age × VIP 0–3 × VIP 3–5[d]	P[b]
Social Skills[e]	0.06 (−0.15 to 0.28)	.58	−0.01 (−0.23 to 0.20)	.92	0.01 (−0.003 to 0.02)	.14	0.02 (−0.01 to 0.03)	.31
Attention Problems	−0.23 (−0.43 to−0.03)	.03	−0.07 (−0.27 to 0.13)	.49	0.002 (−0.01 to 0.01)	.98	−0.03 (−0.06 to 0.001)	.06
Hyperactivity	−0.38 (−0.62 to −0.13)	.002	−0.09 (−0.33 to 0.15)	.46	−0.02 (−0.03 to −0.003)	.02	−0.02 (−0.04 to 0.01)	.23
Aggression	−0.17 (−0.34 to −0.01)	.04	−0.13 (−0.30 to 0.03)	.12	−0.01 (−0.02 to −0.01)	.04	−0.01 (−0.03 to 0.01)	.34
Externalizing Problems	−0.31 (−51 to −0.11)	.003	−0.13 (−0.33 to 0.07)	.20	−0.02 (−0.03 to −0.004)	.01	−0.02 (−0.04 to 0.01)	.20

[a] MLM coefficient predicting difference between intervention and control in BASC-2 mean T-scores in SD units (Cohen's d) across the 3 to 4.5 y period; models included age and dummy coded VIP 0–3 and VIP 3–5.
[b] P values were based on MLMs.
[c] MLM coefficient predicting additional difference in BASC-2 T-scores for families assigned to VIP 3–5 for each mo after second random assignment (regardless of enrollment random assignment status); models additionally included age × VIP 3–5 interaction term.
[d] MLM coefficient predicting additional difference in BASC-2 T-scores for families assigned to both VIP 0–3 and VIP 3–5 for each mo since second random assignment; models additionally included age × VIP 0–3 × VIP 3–5 interaction term.
[e] Higher T-scores indicate better outcomes for Social Skills and worse outcomes for other subscales.

such programs to promote social-emotional development as reflected through reductions in disruptive behaviors. With the effect sizes, it is suggested that such programs can result in clinically important differences on long-term educational outcomes, given the central role of behavior for child learning.[2] There is high potential for scalability of the VIP together with relatively low-cost support integration and alignment with existing initiatives through home visiting and community-based intervention (eg, Administration for Children and Families' Maternal, Infant, and Early Child Home Visiting,[44] Bridging the Word Gap,[45] Providence Talks,[46] City's First Readers,[47] and Thirty Million Words[48]) and dissemination within well-child care.

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ABBREVIATIONS

ARR: absolute risk reduction
BASC: Behavior Assessment System for Children
BASC-2: Behavior Assessment System for Children, Second Edition
BB: Building Blocks
BHC: Bellevue Hospital Center
CI: confidence interval
MLM: multilevel model
NNT: number needed to treat
RCT: randomized controlled trial
ROR: Reach Out and Read
RRR: relative risk reduction
SES: socioeconomic status
VIP: Video Interaction Project
VIP 0-3: Video Interaction Project phase birth to 3 years
VIP 3-5: Video Interaction Project phase 3 to 5 years

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