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Can typical US home visits affect infant attachment? Preliminary findings from a randomized trial of Healthy Families Durham

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ABSTRACT

US government-funded early home visiting services are expanding significantly. The most widely implemented home visiting models target at-risk new mothers and their infants. Such home visiting programs typically aim to support infant–parent relationships; yet, such programs' effects on infant attachment quality per se are as yet untested. Given these programs' aims, and the crucial role of early attachments in human development, it is important to understand attachment processes in home visited families. The current, preliminary study examined 94 high-risk mother–infant dyads participating in a randomized evaluation of the Healthy Families Durham (HFD) home visiting program. We tested (a) infant attachment security and disorganization as predictors of toddler behavior problems and (b) program effects on attachment security and disorganization. We found that (a) infant attachment disorganization (but not security) predicted toddler behavior problems and (b) participation in HFD did not significantly affect infant attachment security or disorganization. Findings are discussed in terms of the potential for attachment-specific interventions to enhance the typical array of home visiting services.

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The landmark Affordable Care Act passed by the US Congress in 2010 included \$1.5 billion to initiate the first national Maternal, Infant, and Early Childhood Home Visiting (MIECHV) Program. MIECHV funds are awarded to states and territories to provide home visiting services to pregnant women and parents with young children. MIECHV grantees must spend at least 75% of their funds to implement one of the 20 “evidence-based” home visiting models designed to support early parenting and child development (Avellar & Supplee, 2013; Health Resources and Services Administration, 2015). The most widely implemented home visiting models focus on at-risk new mothers and their infants and include the well-established and comprehensive Early Head Start (home-based option), Nurse–Family Partnership, and Healthy Families America programs. All three broad-based programs are grounded in attachment theory, and all

aim to support infant–parent relationships (Harding, Galano, Martin, Huntington, & Schellenbach, 2007; Olds, 2006; US Department of Health and Human Services, 1994). The Healthy Families America program is, moreover, “designed to promote positive parent-child relationships and healthy attachment” (Healthy Families America, 2015). Such home visiting programs’ effects on infant attachment quality are as yet untested, however. Given the crucial role of early attachments in human development, it is important to understand attachment processes in home visited families. In the current study, we supplemented an ongoing randomized trial of one Healthy Families program to examine (a) infant attachment security and disorganization as predictors of toddler behavior problems and (b) program effects on attachment security and disorganization.

Effectiveness of major US home visiting programs

The three major US home visiting programs have all been rigorously evaluated. The federally funded Early Head Start program serves low-income families with infants and toddlers, with services offered from pregnancy through the child’s third year. A multisite, longitudinal randomized evaluation of 17 of the first funded Early Head Start programs ($n = 3001$) demonstrated numerous positive – if modest – effects of Early Head Start home visits on observed parenting behaviors at age 3, including maternal “supportiveness,” a composite index of sensitive, positive, and cognitively stimulating behaviors (Love et al., 2005).

The Nurse–Family Partnership serves first-time, at-risk (teen, unmarried, and/or low socioeconomic status (SES)) mothers from pregnancy through the child’s second year. Three randomized evaluations of the Nurse–Family Partnership ($ns = 400, 1138, \text{ and } 735$, respectively) have demonstrated wide-ranging positive effects on outcomes including observed “sensitive/responsive” mother–infant interaction, official reports of child maltreatment, and child behavior problems and cognitive and language development (Kitzman et al., 1997; Olds, Henderson, Chamberlin, & Tatelbaum, 1986; Olds, Henderson, & Kitman, 1994, 2014; Olds et al., 2002, 2004). Importantly, effects have typically been concentrated among relatively higher risk mothers with “low psychological resources” (e.g. Kitzman et al., 2010, 2014; Olds et al., 2004).

Initially designed as a child abuse prevention initiative, the Healthy Families program serves high-risk mothers from pregnancy through the child’s third year. Program effects have been inconsistent and have varied considerably by site (Harding et al., 2007). A randomized evaluation of Healthy Families New York found program impacts on observed “positive” parenting, a composite index including praise, reassurance, and cognitive stimulation (Rodriguez, Dumont, Mitchell-Herzfeld, Walden, & Green, 2010). A randomized evaluation of Healthy Families Alaska demonstrated no effects on official reports of child maltreatment or maternal reports of severe physical discipline (Duggan et al., 2007) but did indicate positive effects on children’s cognitive development (Bayley scores) and on maternal reports of internalizing and externalizing behavior problems (Caldera et al., 2007).

The generally mixed evidence of effectiveness of early home visiting has motivated investigations of home visiting implementation which in turn have revealed wide variation in program quality as well as important implementation factors to consider (Casillas, Fauchier, Derkash, & Garrido, 2016; Daro, McCurdy, Falconner, & Stojanovic,

2003; Duggan et al., 2000). With respect to service “dose,” the existing literature is equivocal. One study of over 800 participants from 17 Healthy Families programs found that the total number of home visits received during an approximately 3-year period ranged from 0 to 151, with a mean of 31.2 (SD = 28.7; Daro et al., 2003). In the Healthy Families Alaska trial, a higher dose of home visits did not enhance program impact, however (Duggan et al., 2007).

A recent meta-analysis of nine home visiting programs, including Early Head Start, the Nurse–Family Partnership, and Healthy Families, highlighted reflective supervision of home visitors and quality of program fidelity monitoring as important predictors of program effectiveness (Casillas et al., 2016; see also Beam, O’Brien, & Neal, 2010). Extending previous findings from the Nurse–Family Partnership emphasizing the importance of *nurse* home visitors, per se (Olds et al., 2002), Casillas and colleagues (2016) also found stronger program effects for programs employing professional versus paraprofessional home visitors. Finally, a secondary analysis of data from the Early Head Start national evaluation highlighted degree of program implementation, with more “fully implemented” home-based Early Head Start programs (those adhering closely to performance standards) demonstrating stronger impacts on children’s cognitive and socio-emotional development (Jones Harden, Chazan-Cohen, Raikes, & Vogel, 2012).

The roles of infant attachment in human development and home visiting

Both attachment and developmental psychopathology perspectives emphasize the unique role of the infant–parent attachment as a cornerstone of human development that strongly affects the negotiation of subsequent developmental tasks (Sroufe, 1979; Toth, Gravener-Davis, Guild, & Cicchetti, 2013). A large literature including descriptive, meta-analytic, and experimental studies, moreover, has confirmed the influence of the infant–parent attachment per se on an array of crucial developmental processes in both high- and low-risk families (see Thompson, 2016, for a review). For example, in the prospective, longitudinal Minnesota Study of Risk and Adaptation in low-income families, infant attachment security predicted early problem-solving skills, interactions with peers and friends, and adolescent mental health (Sroufe, Egeland, Carlson, & Collins, 2005; see McElwain, Cox, Burchinal, & Macfie, 2003, for similar findings from the prospective, longitudinal NICHD Study of Early Child Care). Infant attachment security has also been found to predict social cognitive processes such as (more benign) attributional biases (see Dykas & Cassidy, 2011, for a review). Several recent meta-analyses have identified infant attachment security as a protective factor for social competence with peers (Groh et al., 2014; Pallini, Baiocco, Schneider, Madigan, & Atkinson, 2014) and attachment insecurity as a risk factor for later behavior problems (Fearon, Bakermans-Kranenburg, van Ijzendoorn, Lapsley, & Roisman, 2010; Groh, Fearon, van Ijzendoorn, Bakermans-Kranenburg, & Roisman, 2016; Groh, Roisman, van Ijzendoorn, Bakermans-Kranenburg, & Fearon, 2012; Madigan, Atkinson, Laurin, & Benoit, 2013).

Experimental studies of attachment have further illustrated the influence of infant attachment security (see Berlin, Zeanah, & Lieberman, 2016, for a review). For example, two randomized trials of the *Attachment and Biobehavioral Catch-up* (ABC) program have demonstrated positive effects on infant attachment security and disorganization (Bernard et al., 2012) and on longer term child outcomes including perspective taking

(Lewis-Morrarty, Dozier, Bernard, Terracciano, & Moore, 2012), executive functioning (Lind, Raby, Caron, Roben, & Dozier, 2017), and diurnal patterns of cortisol production (indexing healthier physiological regulation; Bernard, Hostinar, & Dozier, 2015). Randomized evaluations of the Child–Parent Psychotherapy program have demonstrated similarly positive effects (e.g. Cicchetti, Rogosch, Toth, & Sturge-Apple, 2011). Taken as a whole, this literature not only confirms the influential role of infant–parent attachment in later development but also shows infant attachment quality to predict many of the outcomes sought by typical home visiting programs.

The significant expansion of US government-funded early home visiting services is consistent with the perspectives of the attachment and developmental psychopathology fields. Moreover, the evidence of positive effects on both parenting and child outcomes supports home visiting programs' theoretical models and implementation strategies. At the same time, home visiting models demonstrate room for improvement. A recent systematic review illustrated that most programs showed more nonsignificant effects than statistically significant, positive effects (Avellar & Supplee, 2013). Evidence of the key developmental role played by early attachments raises the question of whether typical home visiting services might strengthen their impacts by targeting infant attachment security, *per se*, through the use of attachment-specific interventions. A related but as yet unanswered question concerns whether typically configured home visiting programs that aim to improve infant–parent relationships but do not include attachment-specific interventions demonstrate any fortuitous spillover into the attachment domain. The current study addressed this question.

The current study

To our knowledge, this study is the first to analyze the effects of broad-based home visiting services on infant attachment security, *per se*. Attachment security derives specifically from parents' own attachment representations and *sensitive* parenting behaviors, characterized by contingent responsiveness to infants' behavioral cues, especially those of distress (Fearon & Belsky, 2016; Verhage et al., 2016). Moreover, in two meta-analyses of attachment interventions, Bakermans-Kranenburg and her colleagues found stronger effects on attachment security for those interventions that had at least moderately strong effects on sensitivity (Bakermans-Kranenburg, van Ijzendoorn, & Juffer, 2003), and positive effects on attachment disorganization only for those interventions that focused singularly on maternal sensitivity (Bakermans-Kranenburg, Van Ijzendoorn, & Juffer, 2005). Attachment scholars have also discussed the importance of attachment interventions targeting caregivers' attachment representations and reflectiveness (Berlin, 2005; Slade, 2016; Steele & Steele, 2008). Thus, we speculated that without explicitly targeting maternal sensitivity and/or attachment representations, effects on infant attachment outcomes in the current study would *not* be obtained.

At the same time, given that Healthy Families programs aim to “promote healthy attachment,” and that similar home visiting programs have demonstrated positive effects on attachment-relevant parenting behaviors (e.g. “sensitive/responsive” mother–infant interactions; Olds et al., 2002), we questioned whether a well-implemented Healthy Families program in fact could affect attachment outcomes. We capitalized

on the opportunity to explore this question in the context of a randomized controlled trial (RCT) of one Healthy Families program in Durham, North Carolina.

The RCT of the Healthy Families Durham (HFD) home visiting program enrolled 258 high-risk families during pregnancy and followed them until the children were 3 years of age. An evaluation of program effects on age 3 child and family outcomes is in progress (O'Donnell et al., 2017). The current study focused on attachment processes during the infant/toddler period by adding laboratory-based Strange Situation procedures for 94 infant–mother dyads. We examined two questions. First, to confirm the developmental influence of infant attachment quality in the current sample of high-risk families, we analyzed infant attachment security and disorganization as predictors of mother-reported behavior problems at age 2. Second, we tested the effects of HFD on infant–mother attachment security and disorganization.

Method

Study design and sample

The HFD trial was designed collaboratively by university-based researchers, HFD staff, and administrators of “Baby Love,” a community-based, Medicaid-funded program serving low-income pregnant women and their families. The Baby Love program linked the family with a social worker or nurse to assist with health-care needs during pregnancy and for 2 months after delivery. Although all Healthy Families programs are designed to serve “parents facing [significant] challenges,” individual Healthy Families programs select for themselves the specific characteristics of the families they serve and the specific assessments they use to identify program families (Healthy Families America, 2015). For the purposes of the HFD trial, program and research eligibility criteria were identical. Referrals to both the program and the research study were coordinated with the Baby Love program.

Baby Love staff administered a brief psychosocial interview to all program participants during their first prenatal visit. Those Baby Love participants who met all of the following eligibility criteria were invited to participate in the HFD program and in the trial: first-time mother, absence of moderate-to-severe cognitive impairment or acute psychiatric symptoms, and endorsement of at least one of the following six binary risk factors: maternal age of 16 or younger, self-reported history of childhood maltreatment (assessed according to 5 items adapted from the Parent–Child Conflict Tactics Scale [Straus, Hamby, Finkelhor, Moore, & Runyan, 1998]), mental health symptoms during the past 12 months (assessed according to 4 items adapted from the Composite International Diagnostic Interview Short Form [Kessler, Andrews, Mroczek, Ustun, & Wittchen, 1998a; Kessler et al., 1998b]), history of or current concerns about use of alcohol or other addictive substances (assessed according to 13 items developed by the Baby Love program), history of or current concerns about domestic violence (assessed according to 4 items developed by the Baby Love program), and/or low social support (1 item asking about the availability of “someone whom you can count on, who will help you take care of your baby”). During the RCT period, referrals to HFD from any other community agencies or sources were routed through the Baby Love program.

During the 58-month RCT period (March 2005–December 2009), 336 of 428 eligible Baby Love participants (79%) agreed to be randomized. These participants subsequently

met with a research assistant who confirmed their eligibility criteria, collected informed consent, and informed participants of their group assignment. Participants were randomly assigned to one of four groups. The “HFD-36” group followed the national Healthy Families model and received HFD services until the child’s third birthday. The “HFD-18” group followed an exploratory, reduced service model and received HFD services until the child was 18 months of age. A “Yearly Check-Up” control group participated in annual research assessments without any Healthy Families services. The “Services as Usual” group ($n = 78$) was not seen again after randomization. Randomization was balanced across groups based on primary language (English or Spanish). The resulting analytic sample included 258 families, with 74 families randomly assigned to HFD-36, 75 families randomly assigned to HFD-18, and 109 randomly assigned Yearly Check-Up control families (O’Donnell et al., 2017).

For the current study, when the children turned 12 months of age, mothers were invited to participate in one additional research activity, the Strange Situation procedure. By this time, approximately half of the mothers had dropped out of the larger randomized trial. In addition, 25 mothers were retrospectively determined to be ineligible (due to research assistant error in confirmation of prenatal risks). Of 129 mothers (92 HFD and 37 controls) who could be located and contacted in person or by phone when their children were 12 months of age, 103 (80%) were successfully recruited to complete the Strange Situation procedure with their child. Of these 103, 9 were among those retrospectively determined to be ineligible, resulting in an analytic sample of 94. Until children turned 18 months of age, the HFD-36 and HFD-18 families were offered identical HFD services. Thus, for the purposes of the current study, the HFD-36 and HFD-18 groups were combined into one “HFD” intervention group. The current analytic subsample ($n = 94$) included 67 families randomly assigned to HFD and 27 randomly assigned control families.

In order to examine the extent to which the current/Strange Situation sample had the same characteristics as that of the original HFD trial, following Schafer and Kang (2008), we generated propensity scores by regressing seven maternal prenatal characteristics (race/ethnicity, age, maltreatment history, mental health symptoms, substance use, past or current domestic violence concerns, and low social support) on group membership (original trial or current/Strange Situation study; $n_s = 155$ and 93, respectively, accounting for listwise deletion of missing data). Inspection of box plots of the distributions of propensity scores for the two groups revealed sufficient overlap between the original and current samples to indicate no systematic differences between the two.¹

We also examined statistical power using G*Power software version 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009). Estimating at least .80 power and a significance level of .05, power analyses indicated that a sample of 143 would have been required to detect a modest intervention effect ($d = 0.30$; Cohen, 1988). An even larger sample would have been required to detect a smaller intervention effect. It is important to acknowledge, thus, that the current study’s sample size ($n = 94$), dictated primarily by the larger trial, makes this study preliminary. At the same time, capitalizing on the opportunity to leverage the considerable resources of the original randomized trial to address an important and heretofore undressed research question, this study provided a valuable – if preliminary – examination of the effects of HFD on infant–mother attachment security and disorganization.

Table 1. Prenatal and child characteristics by program group.

Participant characteristics	Full sample (n = 94) (%)	HFD group (n = 67) (%)	Control group (n = 27) (%)	Test of group differences
Maternal race/ethnicity				
Black	68.1	68.7	66.7	χ^2 (1) = 0.04
Hispanic	27.7	26.9	29.6	χ^2 (1) = 0.07
Other	4.3	4.5	3.7	χ^2 (1) = 0.03
Spanish (primary language)	24.5	23.9	25.9	χ^2 (1) = 0.04
Single parent	96.7	96.9	96.0	χ^2 (1) = 0.05
Maternal age ≤ 16	24.5	25.4	22.2	χ^2 (1) = 0.10
Maternal maltreatment history (n = 93)	29.0	28.4	30.8	χ^2 (1) = 0.05
Mental health symptoms	48.9	46.3	55.6	χ^2 (1) = 0.66
Substance use	14.9	19.4	3.7	χ^2 (1) = 3.74 [#]
Domestic violence	16.0	16.4	14.8	χ^2 (1) = 0.04
Low social support	34.0	38.8	22.2	χ^2 (1) = 2.36
Child sex (1 = female)	50.0	53.7	40.7	χ^2 (1) = 1.30
Child age at Strange Situation (mean [SD])	16.5 (3.3)	16.3 (3.4)	17.0 (3.3)	t (92) = 0.95

[#]p < .10.

Table 1 illustrates maternal prenatal and child characteristics for the current analytic sample as a whole and by group.

Almost all mothers identified themselves as single (96.7%) and as either Black (68.1%) or Hispanic (27.7%). Approximately, one-quarter (24.5%) identified Spanish as their primary language. At the time of their first prenatal visit, the mean maternal age was 20.1 years (SD = 4.6). Approximately, half of the mothers reported mental health symptoms, one-third reported low social support, and more than one-quarter reported being maltreated as a child. The current sample had an equal number of male and female children. At the time of the Strange Situation, the mean child age was 16.5 months. There were no significant differences in participant characteristics between the HFD intervention and control groups (see **Table 1**).

The HFD intervention

The HFD program is fully credentialed as a national Healthy Families America program. Developed by Prevent Child Abuse America in 1992, the Healthy Families America program is currently implemented in over 600 sites (Healthy Families America, 2015). The program is described as built upon “attachment and bio-ecological systems theories and the tenets of trauma-informed care,” and, as noted, as designed to “promote healthy attachment” (Healthy Families America, 2015). HFA-credentialed programs’ implementation quality is verified through rigorous quality assurance and accreditation processes conducted every 4 years through detailed reviews and site visits. The HFD program has consistently demonstrated fidelity to all of the “best practice standards” of implementation.

Healthy Families America home visitors are typically college graduates. The majority of HFD home visitors are social work and counseling professionals with Master’s degrees. All Healthy Families America programs are required to enroll parents prenatally or within 3 months of the target child’s birth. The HFD home visiting schedule followed the Healthy Families America guidelines for weekly visits for 1 year followed by regular but fewer visits as family needs indicated.

HFD home visitors focus on increasing parents’ knowledge of child development, fostering positive parent–child interactions, and improving family members’ health,

safety, and literacy. The HFD program incorporates the evidence-informed and widely used Parents as Teachers curriculum, a parent education tool designed to promote all aspects of child development (Parents as Teachers National Center, 2010; Wagner & Spiker, 2001). The curriculum includes guided discussions between the home visitors and mothers, supplemented by handouts, on such topics as the importance of infant–parent relationships in promoting children’s socioemotional development. Weekly visits are individualized to the child’s age and developmental level and to the parent’s concerns and interests. For each visit, home visitors bring simple toys and activities designed to encourage parent–child interaction. The HFD program also incorporates specific supplemental protocols for screening and responding to crisis situations including domestic violence, maternal suicidal risk, and substance abuse. The HFD program closely monitors home visitors’ program adherence and fidelity to the Healthy Families America program standards and Parents as Teachers curriculum. These factors are reviewed during weekly supervision with a licensed clinical social worker to provide quality assurance as well as reflective support. Thus, HFD is a strongly implemented program, adhering to and supplementing the national Healthy Families America best practice standards required for accreditation. Moreover, the Durham program’s hiring of professional home visitors, careful attention to model fidelity, and use of reflective supervision are practices associated with home visiting effectiveness (Casillas et al., 2016). The program does not specifically target attachment security or include an attachment intervention protocol, however.

For the HFD trial, the number of home visits received was calculated annually by child age. In the current sample, by age 1, the number of HFD home visits received ranged from 0 to 59, with a mean (SD) of 23.55 (16.28). This mean includes 12 families (18% of the intervention group) who dropped out immediately and received no home visits at all. Excluding the dropouts, the number of HFD home visits received ranged from 0 to 59, with a mean (SD) of 28.69 (13.18).² This study’s mean number of home visits by age 1 is consistent with or higher than those reported in similar trials. For example, in the Healthy Families New York trial, the mean number of home visits received by age 1 was 21 (Rodriguez et al., 2010). In the randomized trials of both Healthy Families Hawaii and Healthy Families Alaska, the mean number of home visits received by age 1 was 22, not including dropout families, which likely inflated these means (Duggan et al., 2000, 2007).

Assessment of infant attachment quality

Mothers and infants came to a community-based site to complete the standard Strange Situation assessment of infant attachment quality (Ainsworth, Blehar, Waters, & Wall, 1978). This 20-min, video-recorded procedure includes two brief separations and reunions. Trained research assistants administered the procedure in English or Spanish, according to the mother’s preference. All participants were provided transportation to the laboratory and \$75 compensation.

Following Ainsworth et al. (1978) and Main and Solomon (1990), two trained and reliable coders who were blind to any information about the study classified attachment quality. Both coders passed the Minnesota reliability test (at least 80% agreement with master coders at the University of Minnesota). Infants classified *secure* seek proximity to and/or contact with the parent during the reunions, reestablishing their use of the

parent as a secure base from which to explore the environment. Insecurely attached infants are characterized by their inability to use the parent as a secure base. *Insecure-avoidant* infants avoid proximity and/or contact during the reunions. *Insecure-ambivalent* infants simultaneously seek and resist proximity and contact. *Disorganized* infants are characterized by a lack of a coherent behavioral strategy during the reunions, exhibiting disoriented, fearful, and/or contradictory behaviors toward the parent.

Thirty eight (40%) of the Strange Situation videos, 15 randomly selected and 23 identified by the primary coder as difficult to code/coded with low confidence (rated 1 or 2 on a 5-point scale of coder confidence), were double coded. Coder agreement across the four groups was 84% ($\kappa = .78, p < .001$). There were 46 (49%) infants classified as secure, 12 (13%) infants classified as insecure-avoidant, 13 (14%) infants classified as insecure-ambivalent, and 23 (25%) classified as disorganized. For the purposes of this study, we further classified infants as (a) secure/insecure (avoidant, ambivalent, and disorganized) and (b) disorganized/organized (secure, avoidant, and ambivalent). Coder agreement for the secure/insecure groups was 90% ($\kappa = .78, p < .001$). Coder agreement for the disorganized/organized groups was 92% ($\kappa = .77, p < .001$). Coder disagreements were resolved by conference.

Assessment of toddler behavior problems

For the main HFD trial, when children were 2 years old, mothers completed the *Child Behavior Checklist for Ages 1½ to 5* (CBCL; Achenbach & Rescorla, 2001). This widely used assessment asks about the frequency of 99 child behaviors within the past 6 months that often cooccur to create behavior problems (e.g. easily frustrated, hits, shows panic). Mothers responded to each item on a 3-point scale (0 = *never*, 1 = *sometimes*, 2 = *often*). We examined three CBCL scales: (a) the total scale, reflecting multiple behavioral and somatic problems (99 items; $\alpha = .94$); (b) the internalizing behavior problems subscale (36 items; $\alpha = .86$); and (c) the externalizing behavior problems scale (24 items; $\alpha = .89$). Total behavior problem scores ranged from 1 to 92 (mean [SD] = 32.70 [19.12]), internalizing behavior problem scores ranged from 0 to 36 (mean [SD] = 7.94 [6.51]), and externalizing behavior problem scores ranged from 0 to 33 (mean [SD] = 12.36 [7.28]).

Results

Preliminary analyses

Table 2 illustrates bivariate correlations among participant characteristics, number of home visits by age 1, attachment classifications, and behavior problem scores.

Most significant correlations were in predictable directions with the exception of low social support, which was negatively correlated with maternal mental health symptoms and positively correlated with infant attachment security. Child sex was related to attachment security and disorganization such that girls were more likely to be classified secure and less likely to be classified disorganized; 74% of the disorganized infants were male. Older infants were also more likely to be classified disorganized than younger infants. Maternal race (self-identifying as Black) and age (16 years old or younger at the


Table 2. Correlations among participant characteristics, number of home visits, attachment classifications, and behavior problem scores.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
1. Black	—																			
2. Hispanic	-.90*	—																		
3. Other race	-.31*	-.13	—																	
4. Spanish	-.78*	.81*	-.00	—																
5. Single parent	.14	-.02	-.26*	-.04	—															
6. Child sex (1 = female)	-.09	.10	.00	-.03	-.06	—														
7. Child age at Strange Situation	.00	-.01	.00	.06	.13	.03	—													
8. Mat. age ≤ 16	-.09	.15	-.12	.19 [#]	.11	.07	.16	—												
9. Maltreatment	-.18 [#]	.15	.10	.09	-.01	-.11	.03	-.19 [#]	—											
10. Mental health symptoms	.03	-.13	.22*	-.11	-.06	.04	.06	-.31*	.04	—										
11. Substance use	.16	-.13	-.09	-.10	-.10	.06	-.20 [#]	-.10	.06	-.17	—									
12. Domestic violence	.05	-.08	.05	-.11	-.09	.15	-.01	-.25*	.04	.27*	.06	—								
13. Low social support	-.18	.16	.07	.22*	.00	.05	-.05	-.10	-.11	-.25*	.02	-.19 [#]	—							
14. Home visits by age 1 (n = 67)	-.32*	.21 [#]	.27*	.25*	-.20	.04	.18	-.12	.43*	-.04	.05	-.03	.23*	—						
15. Attachment security (1 = Secure)	-.11	.06	.11	.09	-.06	.34*	-.13	.14	-.15	-.11	.01	.10	.24*	.04	—					
16. Attachment disorganization (1 = D)	.12	-.08	-.12	-.15	.11	-.27*	.22*	.08	.02	.09	-.10	-.05	-.15	-.09	-.56*	—				
17. CBCL total	-.23*	.20 [#]	.11	.13	-.04	.03	.04	-.25*	.10	.06	-.06	.10	.11	.12	-.08	.17	—			
18. CBCL int.	-.31*	.25*	.15	.22*	-.08	-.01	.05	-.21 [#]	.13	-.03	-.07	.03	.12	.22 [#]	-.01	.13	.88*	—		
19. CBCL ext.	-.09	.05	.09	-.04	.01	.06	.05	-.22*	.09	.04	-.03	.09	.14	.03	-.09	.13	.64*	.89*	—	

[#]p < .10, *p < .05.

CBCL: Child Behavior Checklist for ages 1.5 to 5.

time of the first prenatal visit) were associated with lower maternal ratings of children's total and internalizing behavior problems.

With respect to intervention dose, maternal race/ethnicity was related to the number of home visits received by age 1, with mothers who self-identified as Black receiving relatively fewer home visits, and Spanish-speaking mothers and those who self-identified as "other" receiving relatively more. In addition, mothers with a history of childhood maltreatment as well as those who reported low social support received relatively more home visits in their child's first year. There were no significant bivariate associations between intervention dose and attachment security or disorganization or behavior problem scores.

Principal analyses

Infant attachment quality as a predictor of toddler behavior problems

We conducted six hierarchical regressions to test the associations between attachment security and disorganization and children's total, internalizing, and externalizing behavior problem scores. Given the preliminary findings just described, the first step of each model included the following covariates: low social support, child sex, child age, maternal race (Black/non-Black), maternal age ($\leq 16/\geq 17$), and program group (HFD/control). The second step of the model added attachment security or disorganization. Attachment security did not add significantly to the prediction of behavior problem scores (see Table 3).

Attachment disorganization, however, did significantly predict total behavior problem scores and marginally predicted both internalizing and externalizing behavior problems, over and above the step 1 covariates (see Table 4).

HFD effects on attachment quality

Using intent-to-treat analyses, we tested effects on attachment for all participants randomly assigned to the HFD group, regardless of the intervention dose (number of home visits) actually received. We first conducted bivariate analyses of attachment classifications by program group. There were no significant program group differences

Table 3. Hierarchical regressions predicting child behavior problems at age 2 from infant attachment security.

Predictor	CBCL total				CBCL internalizing				CBCL externalizing			
	B	SE (B)	β	ΔR^2	B	SE (B)	β	ΔR^2	B	SE (B)	β	ΔR^2
Step 1				.14 [#]				.16*				.10
Maternal race (1 = Black)	-9.84	4.47	-.24*		-4.49	1.51	-.32*		-1.00	1.73	-.06	
Child sex (1 = female)	1.91	4.20	.05		-0.43	1.42	-.03		1.68	1.63	.12	
Child age at Strange Situation	0.33	0.60	0.06		0.15	0.20	.08		0.12	0.23	.06	
Maternal age ≤ 16	-11.23	4.82	-.25*		-3.45	1.63	-.23*		-3.54	1.87	-.21 [#]	
Low social support	2.90	4.43	.07		0.74	1.49	.05		2.31	1.72	.15	
Program group (1 = HFD)	-2.98	4.45	-.07		-0.50	1.50	-.04		-2.16	1.73	-.14	
Step 2				.01				.00				.01
Attachment security	-3.81	4.38	-.10		-0.25	1.48	-.02		-1.78	1.70	-.12	
Total R^2				.14 [#]				.16*				.11

[#] $p < .10$, * $p < .05$.

HFD: Healthy Families Durham; CBCL: Child Behavior Checklist for ages 1.5 to 5.

Table 4. Hierarchical regressions predicting child behavior problems at age 2 from infant attachment disorganization.

Predictor	CBCL total				CBCL internalizing				CBCL externalizing			
	<i>B</i>	SE (<i>B</i>)	β	ΔR^2	<i>B</i>	SE (<i>B</i>)	β	ΔR^2	<i>B</i>	SE (<i>B</i>)	β	ΔR^2
Step 1				.14 [#]				.16*				.10
Maternal race (1 = Black)	-10.45	4.36	-.25*		-4.71	1.48	-.33*		-1.14	1.71	-.07	
Child sex (1 = female)	3.30	4.06	.09		0.14	1.38	.01		1.94	1.60	.13	
Child age at Strange Situation	0.14	0.59	.02		0.08	0.20	.04		0.07	0.23	.03	
Maternal age ≤ 16	-12.25	4.62	-.27*		-3.56	1.57	-.23*		-3.97	1.82	-.23*	
Low social support	2.96	4.21	.07		0.94	1.43	.07		2.18	1.66	.14	
Program group (1 = HFD)	-3.34	4.34	-.08		-0.59	1.48	-.04		-2.28	1.71	-.14	
Step 2				.05*				.03 [#]				.03 [#]
Attachment disorganization	10.77	4.77	.24*		2.78	1.62	.19 [#]		3.32	1.88	.20 [#]	
Total R^2				.19*				.19*				.13

[#] $p < .10$, * $p < .05$.

HFD: Healthy Families Durham; CBCL: Child Behavior Checklist for ages 1.5 to 5.

Table 5. Attachment classifications by program group.

Attachment classifications	Program group	
	HFD (<i>n</i> [%])	Control (<i>n</i> [%])
Attachment security		
Secure	34 (51)	12 (44)
Insecure	33 (49)	15 (56)
Attachment disorganization		
Organized	51 (76)	20 (74)
Disorganized	16 (24)	7 (26)

HFD: Healthy Families Durham.

in the likelihood of an infant being classified secure ($\chi^3[1] = 0.31, p = .58$) or disorganized ($\chi^4[1] = 0.04, p = .84$) (see Table 5).

We next conducted two logistic regressions to test the effects of HFD participation on attachment security and disorganization, covarying low social support, child sex, and child age. Participation in HFD did not add significantly to the prediction of infant attachment security or disorganization (see Table 6).

Given limited statistical power and variability in intervention dose, we also explored the number of home visits by age 1 as a predictor of attachment security and disorganization. We conducted two additional logistic regressions including the intervention group only ($n = 67$), examining the number of home visits by age 1 as a predictor of attachment security and disorganization, covarying low social support, child sex, and

Table 6. Logistic regressions predicting attachment security and disorganization by program group.

	Attachment security		Attachment disorganization	
	OR	CI (95%)	OR	CI (95%)
Intercept	1.64	–	0.03*	–
Child sex (1 = female)	4.63*	1.85–11.60	0.22*	0.07–0.67
Child age at Strange Situation	0.91	0.79–1.04	1.19*	1.02–1.40
Low social support	3.05*	1.15–8.07	0.44	0.14–1.44
Program group (1 = HFD)	0.85	0.31–2.32	1.28	0.42–3.92

* $p < .05$; HFD: Healthy Families Durham.

child age. In neither model did number of home visits by age 1 significantly predict attachment security or disorganization.³

Discussion

Given (a) the goals of typical US home visiting programs to support early parent relationships and (b) the crucial role of infant–parent attachment in human development, it is important to understand attachment processes in high-risk families, examined here in the first known study of the effects of broad-based home visiting services on infant attachment, *per se*. This study supplemented a randomized evaluation of the HFD program. As often occurs in studies of high-risk families, the larger randomized trial experienced substantial and differential attrition. This limited the number of participants available to recruit for the current study. Of those invited into this supplemental study, however, a full 80% of both HFD and control dyads participated, allowing us to study a large majority of those participants who were still available to recruit. Moreover, the current study's sample was representative of that of the larger trial, and random assignment remained intact, with no significant differences in initial participant characteristics between the HFD and control groups.

Preliminary findings

All participants demonstrated a substantial degree of prenatal risk. Almost all mothers were single and of minority race or ethnicity. At the time of their first prenatal visit, the mean maternal age was 20, and almost one-quarter was 16 years old or younger. Approximately, half reported mental health symptoms, one-third reported low social support, and more than one-quarter reported being maltreated as a child. The overall distribution of attachment patterns was similar to that reported for low SES samples in van Ijzendoorn and colleagues' (1999) meta-analysis (48% secure, 17% avoidant, 10% ambivalent, and 25% disorganized; van Ijzendoorn et al., 1999). Given that the current sample was recruited on the basis of psychosocial risk and did in fact demonstrate significant risks, the current study's 49% rate of secure attachment may be higher than expectable. Interestingly, approximately three-quarters of the disorganized infants in the current sample were male. This disproportionality fits with the speculations of Lyons-Ruth, Easterbrooks, and Cibelli (1997) that boys are more likely to develop disorganized attachment behaviors than girls. It is also consistent with attachment distributions found in a recent Australian study (Huber, McMahon, & Sweller, 2015). In van Ijzendoorn et al.'s (1999) meta-analysis, child sex did not relate to attachment disorganization, however.

Most of the preliminary, bivariate correlations were in the expected directions. The positive correlation between infant disorganization and child age may have reflected a more strongly rooted and easier to identify set of disorganized behaviors in the older infants. It is curious that low social support was negatively correlated with maternal mental health problems and positively correlated with infant attachment security. Low social support was assessed in the larger trial with one question, "Do you have someone you can count on, who can help you take care of your baby?" A broader assessment of social support may have functioned differently. It is also possible that mothers' appraisals of their support (or lack thereof) reflected

realistic assessments of their relationships and good mental health, which in turn was related positively to parenting and infant attachment security.

Consistent with other home visiting studies (e.g. Daro et al., 2003), we found considerable variation in the number of home visits received by randomly assigned intervention group participants. We also found that higher doses of home visits were received by Spanish-speaking mothers and by mothers who reported a history of childhood maltreatment and/or low social support. Thus, within the randomly assigned intervention group, a full or even standard dose of home visits was not ensured. Rather, more vulnerable, new immigrant, and/or psychosocially at-risk mothers may have directly requested or indirectly elicited more home visits. It is also possible, as has been observed in similar intervention studies, that some extremely high-risk mothers' lives may have been too chaotic to allow for sustained, meaningful engagement in home visiting (e.g. Spieker, Solchany, McKenna, DeKlyen, & Barnard, 1999). Engagement of families of varying levels of risk and tailoring of services to families' specific needs are issues continuing to be addressed in the home visiting literature (e.g. Olds et al., 2015).

Principal findings

In response to our first research question, we found that infant attachment disorganization significantly predicted total behavior problem scores and marginally predicted both internalizing and externalizing behavior problem scores. Surprisingly, attachment security was not related to toddler behavior problems. Our findings are, thus, partially consistent with recent meta-analyses that have identified infant attachment insecurity as a risk factor for internalizing and externalizing behavior problems, and infant disorganization as a risk factor for externalizing (but not internalizing) problems, especially for boys (Fearon et al., 2010, 2016; Groh et al., 2012). Our findings contribute to the currently evolving attachment research literature aiming to elucidate the precise nature of the associations between specific infant attachment patterns and multiple facets of childhood socioemotional development (Groh et al., 2016). Our findings bolster the argument for preventing attachment disorganization, as both disorganization and early behavior problems are risk factors for later mental health disorders (Fearon & Belsky, 2011; Moffitt et al., 2007; Munson, McMahon, & Spieker, 2001; Sroufe et al., 2005). Our analyses would have been strengthened by observational assessments of toddlers' behavior problems. In addition, a stronger indication of attachment security as a protective factor in the current sample may have come from assessments of more positive indicators of social competence such as empathy and perspective-taking skills during early peer interactions. Such assessments were not included in the larger HFD trial, however.

In response to our second and focal research question, we found that participation in HFD did not significantly affect infant attachment security or disorganization. The program does not include attachment-specific intervention protocols; so, this result was not entirely surprising. At the same time, HFD is a fully credentialed, strongly implemented program, monitoring program fidelity and adherence and providing reflective supervision, in addition to employing master-level home visitors and offering supplemental services. The program's Parents as Teachers curriculum includes activities

designed specifically to facilitate positive infant–parent interactions. The mean “dose” of home visits in the first year was comparable to or higher than that reported by several other Healthy Families trials (e.g. Rodriguez et al., 2010). Given the HFD program’s overall goals and specific strengths, we had speculated that if the program was actively enhancing early parenting behaviors, some fortuitous spillover onto attachment outcomes may also have occurred. Such spillover was, however, *not* observed, either in rigorous intent-to-treat analyses of program effects or in exploratory, within-group analyses of the associations between home visiting dose and attachment quality.

The current findings, while preliminary, suggest the difficulty of changing the development of infant attachment security without an attachment-specific intervention protocol. Indeed, even with the use of an attachment-specific intervention, effect sizes are often moderate. For example, the meta-analytic effect on attachment security of those attachment interventions with the strongest effects on maternal sensitivity was $d = 0.45$ (Bakermans-Kranenburg et al., 2003). Bernard et al.’s (2012) significant effect of the ABC program on infant attachment security was $d = 0.38$, and the effect on attachment disorganization was $d = 0.52$. These findings as a whole suggest the need to promote not simply “positive” parent–child interactions and “healthy” attachments but attachment *security*, by targeting maternal sensitivity and/or attachment representations. These findings resonate with observations made by van Ijzendoorn, Bakermans-Kranenburg, and Juffer (2005) who highlighted the merits of attachment interventions that have precise, short-term goals which in turn facilitate adherence to program requirements by intervention providers. Bakermans-Kranenburg and her colleagues (2005) have also emphasized the need for interventions that focus specifically on the prevention of attachment disorganization. Taken together, these findings preliminarily suggest that even well-implemented US home visiting programs, while providing many useful services with positive developmental benefits, are unlikely to prevent attachment disorganization or promote attachment security without explicitly targeting infant–parent attachment, *per se*. We suggest that including attachment-specific interventions in broad-based home visiting services could not only support attachment security but also increase program effects on other targeted outcomes.

Some evidence of the promise of such enhanced approaches is in fact beginning to emerge. In one early effort, a randomized trial of an explicitly attachment-informed, “parenting-focused” home-based Early Head Start program found positive effects on mothers’ *Attachment Q-Set* ratings of their toddlers’ attachment security (Roggman, Boyce, & Cook, 2009). In a recent randomized trial testing home-based Early Head Start services with the addition of the ABC program, initial, qualitative findings indicated strong feasibility and acceptance of this model, with both mothers and Early Head Start staff attesting to the unique benefits of the ABC intervention (Aparicio, Denmark, Berlin, & Jones Harden, 2016; West, Aparicio, Berlin, & Jones Harden, *in press*). Both the ABC program and a relatively new home visiting program, *Minding the Baby*, have recently been approved by MIECHV as “evidence-based.” *Minding the Baby* is a 2-year program that directly targets attachment security by promoting mothers’ sensitive responsiveness and reflectiveness (Slade, Sadler, & Mayes, 2005). A pilot randomized trial has demonstrated positive effects on infant attachment security and disorganization (Sadler et al., 2013).

In conclusion, the current study was the first to analyze the effects of broad-based home visiting services on infant attachment security, *per se*. Major strengths of the study include

the randomized design, intent-to-treat analyses, and use of the gold standard Strange Situation procedure to assess infant attachment quality. Restricted statistical power was the chief study limitation, which in turn limited the robustness of the principal analyses. The control group ($n = 27$) was especially small, and there were relatively few infants classified as disorganized ($n_s = 7$ HFD infants and 16 controls, respectively). A fully powered study may have revealed program effects on attachment security and/or disorganization. Thus, it is important to interpret the current preliminary findings with caution. A larger sample would also have permitted the analysis of moderated effects (testing “what worked for whom”), which have been reported in some other evaluations of Healthy Families (e.g. Duggan, Berlin, Cassidy, Burrell, & Tandon, 2009) and attachment-based interventions (e.g. Cassidy et al., 2017). At the same time, the current study opened an important new area of inquiry. Randomized trials with larger samples are necessary and will provide more definitive findings. Larger trials will also allow for analyses of moderated effects, which may in turn inform improvements in home visiting services.

Notes

1. These findings are available upon request.
2. These numbers include one family who remained in touch with the program but did not receive any home visits until the child’s second year.
3. Given associations between intervention dose and maternal race/ethnicity and maltreatment history, we conducted an additional series of regression models covarying these factors in the prediction of attachment security and disorganization from intervention dose and in all principal regression models. In all models, findings were virtually identical to those that did not include these additional covariates.

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