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Mixed Methods Analysis of Participant Attrition in the Nurse-Family Partnership

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Abstract

Participant attrition is a major influence on the effectiveness of evidence-based interventions. Assessing predictors of participant attrition and nurse and site characteristics associated with it could lay a foundation for increasing retention and engagement. We examined this issue in the national expansion of the Nurse-Family Partnership, an evidence-based program of prenatal and infancy home visiting for low-income, first-time mothers, their children, and families. Using a mixed methods approach, we examined participant, nurse, and site predictors of participant attrition and completed home visits. We used mixed multivariate regression models to identify participant, nurse, program, and site predictors of addressable attrition and completed home visits during pregnancy and the first year of the child's life for 10,367 participants at 66 implementation sites. We then conducted semi-structured interviews with nurse home visitors and supervisors at

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None of the authors has a personal financial interest in the Nurse-Family Partnership (NFP). It should be noted that the Prevention Research Center for Family and Child Health, directed by David Olds at the University of Colorado School of Medicine, currently has a contract with the non-profit organization established to replicate the NFP in community practice (the Nurse-Family Partnership ©); this contract is to conduct research to improve the NFP program and its implementation. DL, MM, EI, and DO were employed by this center during the time that major aspects of this study were conducted. The majority of the work reported here was conducted through the National Center for Children, Families, and Communities at the University of Colorado College of Nursing prior to the creation of the national non-profit.

selected sites with the highest ($N = 5$ sites) and lowest ($N = 6$ sites) rates of participant addressable attrition and employed qualitative methods to synthesize themes that emerged in nurses' descriptions of the strategies they used to retain participants. Mothers who were younger, unmarried, African American, and visited by nurses who ceased employment had higher rates of attrition and fewer home visits. Hispanic mothers, those living with partners, and those employed at registration had lower rates of attrition. Those who were living with partners and employed had more home visits. Nurses in high retention sites adapted the program to their clients' needs, were less directive, and more collaborative with them. Increasing nurses' flexibility in adapting this structured, evidence-based program to families' needs may increase participant retention and completed home visits.

Keywords

Attrition; Retention; Dropout; Engagement; Home visiting

In the past decade, significant progress has been made in identifying preventive interventions that meet high evidentiary standards and that prevent a range of adverse mental health, crime, and substance use outcomes (National Research Council and Institute of Medicine 2009). Implementing evidence-based programs with fidelity increases their public health impact (Durlak and DuPre 2008). One of the greatest challenges in implementing preventive interventions involves ensuring that the target population participates in the program to the same degree as those who participated in the trials (Prinz et al. 2001).

Monitoring participant attrition, identifying factors that might contribute to it, and developing strategies to reduce it are crucial for the successful scaling of evidence-based programs. Some studies have indicated that participants at higher psychosocial risk are more likely to drop out of preventive interventions (Katz et al. 2001; Roggman et al. 2008), while others have suggested that participants at higher risk drop out less (Ammerman et al. 2006). Quantitative predictive analyses identify correlates of attrition and isolate those at most risk, but they provide limited information about how to address the problem. Mixed methods approaches, on the other hand, in which both quantitative and qualitative methods are applied to understand a problem, might lead to more comprehensive understanding of underlying mechanisms and promising strategies to address the problem (Borkan 2004).

In the current study we used a mixed methods approach to understand participant, provider, program, and site predictors of participant attrition and completed home visits in the Nurse-Family Partnership (NFP), a program of prenatal and infancy home visitation for low-income pregnant women and parents of young children that has served as the primary evidentiary foundation for the recently enacted Maternal, Infant, and Early Childhood Home Visitation Program included in the Affordable Care Act (Haskins et al. 2009).

NFP nurses have three primary goals: 1) to improve pregnancy outcomes; 2) to improve children's subsequent health and development; and 3) to increase mothers' personal development, especially their economic self-sufficiency (Olds 2002). During the visits, nurses follow carefully constructed program guidelines designed to promote adaptive parental behavior that promotes accomplishment of program goals, which are thought to align with parents' aspirations for their young children and themselves. Nurses are taught to adapt the content of the program to the needs of families (Korfmacher et al. 1999) in part by following a sequence of activities within visits that explicitly addresses families' needs and promotes nurse-client shared agenda setting for visits.

The NFP employs a visit schedule recommended for all participants: four weekly visits immediately after registration during pregnancy, then visits every other week until birth, weekly visits for 6 weeks following the child's birth, visits every other week until the child is 21 months of age, and then monthly visits until the child's second birthday. This amounts to a total of 61 scheduled visits assuming that women register at the 19th week of gestation (13 visits during pregnancy, 29 visits in the first year of life, and 19 visits during the second year of life). In the trials, nurses completed between 7–9 visits during pregnancy, and 21–26 visits during the first 2 years of the child's life, or about half of the scheduled visits, calculated with the inclusion of all cases that dropped from the program before completion at child age 2.

Since 1996, the NFP has been offered for public investment and currently is operating in 390 counties in 33 states, serving over 23,000 families per year. A web-based information system is used to collect information on participant, nurse, and site characteristics; on program implementation; and on key maternal and child outcomes, which serves as a foundation for continuous quality improvement.

In 2000, NFP attrition rates through the end of the child's second birthday in three states where NFP was widely disseminated were between 60 and 70%, compared to 38% in the most recently completed randomized-controlled trial in Denver (Korfmacher et al. 1999). The rate of completed home visits during pregnancy and the first year of the child's life (including all cases that dropped), on the other hand, were not dramatically different between the last trial and community replication. Nurses in the Denver trial completed a mean of 6.5 (standard error of 0.28) visits during pregnancy and 21.3 (standard error of 0.99) visits during the first 2 years of the child's life (including 13 visits during the child's first year of life). In community replication, nurses completed a mean of 8.4 (standard error of 0.04) visits during pregnancy and a mean of 11.62 (standard error of 0.09) visits in the first year of the child's life. The higher number of completed home visits during pregnancy in community replication is likely due to the requirement that registration be completed before the 28th week of gestation, while in the Denver trial participant registration took place throughout all of gestation.

We conducted the current study to identify factors associated with completed home visits and addressable participant attrition from the NFP; i.e., not due to moving, death, or loss of child custody, and to use this information to guide development of an intervention to improve retention. The study was approved by the Colorado Multiple Institutional Review Board.

We conducted quantitative analyses of implementation data to determine participant, nurse, and site-level predictors of participant attrition; and then conducted a qualitative study of nurses in high- and low-attrition sites to gain insight into how nurses in those two groups of sites approached the retention of participants.

Quantitative Component Methods

The quantitative component of the study addressed the following questions: 1) To what degree do participant, nurse home visitor, and program characteristics predict addressable attrition and number of completed home visits during the pregnancy and infancy phases of the program? 2) Are sites and nurses uniquely predictive of participant attrition and completed home visits, once differences in participant risks for attrition are adjusted statistically?

Sample

Participant, nurse, and site-level variables were derived from the NFP implementation database for all community replication sites from July 1, 1996 through December 31, 2001. Of those sites, only data from sites with at least 50 participants who had an infant who was, or should have been, 1 year old were included in order to insure that we had sufficient numbers of cases within sites to obtain minimally stable estimates of site effects ($N = 66$ sites). Each participant enrolled in the program at these sites was eligible for analysis. These criteria resulted in a final sample of 10,367 participants visited by 798 nurses for the analysis of individual predictors, and 9,631 participants and 786 nurses at those same 66 sites with reasonably complete data available for multivariate analyses.

Measures

NFP nurses administer surveys of participants at regular intervals to assess participants' demographic, social and psychological characteristics, and their health and mental health histories and current functioning. Nurses also complete encounter forms after every completed or attempted visit that characterize features of program implementation, and a "Client Activity Status" form whenever a client drops from the program, including the reason clients ceased receiving services.

Attrition—Attrition before the child's first birthday was specified by reason coded on the Client Activity Form (miscarriage, stillbirth, infant death, maternal death, moving from program catchment area, declined services, excessive missed appointments). If a participant had not been coded as having dropped, but had not received a home visit within 180 days, she was defined operationally as having dropped, a definition consistent with a study of program implementation in the Denver NFP trial (Korfmacher et al. 1999). As noted below, using a shorter interval without a visit to define a drop had little bearing on the results. We defined addressable attrition as having declined services, excessive missed appointments, could not locate, or >180 days without a visit.

A dichotomous variable representing addressable attrition versus active or dropped for non-addressable reasons was created to cover the time from registration during pregnancy through the child's first birthday. All cases enrolled (that is having received an initial home visit) were included. For those cases that dropped before the child's birth, estimates were made of the child's likely birth-date based upon the mother's gestational age at registration. We focused on attrition through child age 1 as opposed to age 2 as this increased the number of sites and participants available for analysis, and the greatest portion of attrition in this program occurs in the first year following the child's birth.

Completed Home Visits—Nurses who deliver this program complete encounter forms that provide basic information on each attempted or completed home visit. For this study, we examined the number of completed home visits from registration sometime before the 28th week of gestation through the child's first birthday (or for those who dropped from the program before child age 1 year, the child's expected first birthday calculated from the reported gestational age of the mother at the time of the first completed home visit, assuming 40 weeks of gestation).

Participant Characteristics—We examined a number of participant characteristics as possible predictors of addressable attrition, including socio-demographic characteristics measured at enrollment during pregnancy: age, race/ethnicity, years of completed education, completed high school (yes/ no), enrolled in school (yes/no), household composition, household income, mother received Medicaid assistance (yes/no), and whether she was employed (yes/no); participant health characteristics: maternal gestational age at enrollment

(weeks), whether she smoked cigarettes (yes/no), and whether she used alcohol, marijuana, or other drugs at registration (yes/no); and participants' symptoms of depression and anxiety (Ware et al. 1985) and sense of mastery (Pearlin and Schooler 1978).

Nurse Characteristics—We examined nurse home visitor length of employment in the NFP (in months) and whether the participant's nurse home visitor left NFP employment before the baby was born as fixed effect predictors of addressable attrition.

Random Effects—We examined two random effects: sites and nurses nested within sites. We only included sites that had at least 50 participants that had reached the child's 12th month of life in order to increase the stability of site effects.

Analyses

We first examined bivariate relationships between these potential predictors of attrition and completed home visits, and then repeated these analyses in multivariate mixed models. In the multivariate models we specified sites and nurses nested within sites as levels of random effects in the analysis of completed home visits, and with sites alone as a random effect in the analysis of addressable attrition, given that the model with nurses specified within sites did not converge when attrition was examined as the outcome. Finally, we repeated the multivariate analyses with a reduced set of predictors derived from stepwise regression, including only those terms that were statistically significant, and variables that had less than 10% missing data. We did not include program implementation variables that were likely to be reflections of the attrition process itself in the multivariate analyses, such as number of missed appointments. We show Odds Ratios (OR) and Adjusted Odds Ratios (AOR) for predictors of addressable attrition and effect sizes expressed as differences in numbers of completed home visits, both adjusted and unadjusted, with 95% confidence intervals. In order to interpret OR for continuous variables, the OR's were computed in standard deviation units.

Results of Quantitative Analyses

Table 1 shows the rates of attrition for specific reasons between the first home visit and the child's first birthday (or expected first birthday). Attrition for non-addressable reasons was 10.1% and attrition for addressable reasons was 39.4%, leading to total attrition of 49.5% from registration during pregnancy through the child's 12th month of life. Table 2 lists the population characteristics and their simple bivariate relationships with addressable attrition and completed home visits. Characteristics of the population can be derived from this table: Mothers' mean age, for example, was 19.48 years, and 18% were Black. Most predictors had highly significant relationships with addressable attrition and/or completed home visits, as would be expected given the large sample size, so significance levels are not shown. Participants whose nurses left the program before the 12th month of the child's life had an OR of 7.77 for addressable attrition and had 7.67 fewer completed visits compared to those whose nurses did not leave the program.

The bottom section of Table 2 shows that features of program implementation during pregnancy predicted attrition and the total number of completed home visits. Larger numbers of no-shows during pregnancy (attempted visits), lower ratios of completed-to-expected home visits, lower ratings of maternal involvement in the home visits, a greater portion of home-visit time spent on maternal personal health and less time on preparation for becoming a mother, as well as less time spent per visit, all predicted attrition and fewer completed home visits.

As shown in Table 3, in the mixed model multivariate regression analyses we collapsed levels of certain discrete predictors to assist with interpretation (e.g., age was classified as 18 vs. >18 at registration). In the analysis of addressable attrition, we included site as a level of a random effect. In the analysis of completed home visits, to assist with interpretation of effects, we included a random effect for nurses nested within sites and a term for addressable attrition, given that attrition and completed home visits are so highly correlated, and we wanted to know the extent to which predictors accounted for completed visits after adjustment for attrition.

Predictors of Attrition

Mothers who were younger (< 18), unmarried, and were African American had higher rates of attrition (AOR = 1.30; AOR = 1.42, and AOR = 1.32, respectively). Mothers who were Hispanic and those living with a husband or boyfriend at registration were less likely to drop out for addressable reasons (AOR = 0.81 and AOR = 0.86, respectively). Those participants whose nurse left the NFP before the end of the child's first birthday were much more likely to drop (AOR = 7.53), as were those visited by nurses who had been employed with the NFP for more months (AOR = 1.08).

Predictors of Completed Home Visits

Participants who had no addressable attrition had 15.6 more completed visits (26.0) than those who dropped for addressable reasons (10.4). Mothers who were younger (< 18), unmarried, and African American had fewer completed home visits (−0.58, −0.61, and −0.34, respectively). Mothers who at registration were living with their own mother, with a husband or boyfriend and were employed had 0.94, 0.67, and 0.38 more completed home visits respectively than did the reference populations. Those participants whose nurse left the NFP before the end of the child's first birthday had 1.72 fewer completed home visits. Those who registered in the NFP later in pregnancy had 1.80 fewer completed home visits for every standard deviation increase in gestational age at registration.

Even after controlling for these individual and nurse factors that predict participant attrition and completed home visits, there were significant differences among sites in rates of addressable attrition and among sites and nurses within sites in predicting the number of completed home visits. This suggested that something was operating at the level of sites and nurses that accounted for these differences. To gain insight into what may explain these differences among sites and nurses, we collected qualitative data from nurses within subsets of NFP sites that had high and low rates of risk-adjusted addressable attrition.

Qualitative Component Methods

We conducted semi-structured interviews with nurse supervisors and nurse home visitors in a subset of 11 NFP sites selected systematically from different regions of the country for having among the highest and lowest rates of participant attrition.

Sample

We identified NFP sites with high and low risk-adjusted attrition through the infants' sixth month of life from the entire population of sites throughout the US. We used attrition through child age 6 months in order to increase the number of potential sites that might be sampled for this portion of the study, given that this work was begun early in the NFP national replication process, and that this procedure would increase the number of sites on which sampling might be based. From these sites ($n = 49$), we selected six low-attrition and six high-attrition sites from four geographic regions of the U.S. (East, Mid-West Plains, Rocky Mountain, and West Coast); we attempted to ensure participant racial/ethnic diversity

within and across high and low attrition sites. Staff members at one of the high attrition sites did not keep the scheduled interviews, which explains the unequal numbers of high- and low-attrition sites. We interviewed two nurse home visitors and a nurse supervisor at each site, with the exception of one of the larger high-attrition sites, where we interviewed four nurses and a nurse supervisor.

Data Collection Procedures

As shown in Table 4, we focused the interviews on four primary topics: a) strategies nurses used to develop the nurse home visitor-participant relationship; b) factors that made it difficult to engage participants in visits; c) indicators nurses used to ascertain whether participants were at risk for attrition; and d) how the nurse responded when participants began to disengage. Nurse supervisors at each of the 11 sites were asked to describe client relationship issues on which nurses sought guidance from them and their perceptions of the skills of nurses who were more or less successful in engaging and retaining clients in the program. The semi-structured interview used with nurse supervisors is shown in Table 5.

All of the interviews were conducted by individuals familiar with the NFP (two doctorally prepared nurse investigators and a program development specialist with a master's degree in counseling). Interviews were audiotaped and later transcribed verbatim. Transcribed interviews were coded using Ethnograph software by a research assistant under the supervision of the nurse investigators. Preliminary codes were then clustered into broad categories and ultimately into themes pertaining to each question.

Results of Qualitative Study

Similarities in Themes Between High and Low Attrition Sites

Nurses and supervisors from all sites emphasized the critical importance of developing a strong therapeutic relationship with participants. Common strategies used to establish trust between the home visitor and participant included assuring participants that the information they shared was confidential, involving other family members in the home visits, sharing selective information about their own experiences and challenges as a parent, and modifying their strategies for delivering program content in accordance with participants' needs.

Differences in Themes Between High- and Low-Attrition Sites

Nurses at sites with low attrition were more uniformly committed to adapting the program to the participants' needs. In particular, nurses at low-attrition sites were more likely to relate the program to women's specific concerns about pregnancy and parenting, to emphasize that the NFP program was designed to be of help to them, and that the nurse home visitor's goal was to help participants achieve their goals for themselves and their babies.

For example, one nurse related "*When I go out, I really try to engage the family...find something that it seems they're interested in and explain how the program can help with that...If I'm just coming out and talking at them, then oftentimes they don't have any ownership of the relationship.*" Another nurse said "*I kind of tell them that the support...it's a program to help you in whatever you want to do in your future life, now that you are pregnant.*" Nurses at low-attrition sites also gave over some control of the programs' schedule and content to the participants in order to better address participants' individual need. "*I pretty much just let them know it is about what they need and what they want. I do have a bunch of material for every visit, but what's most important is what you want. So the materials that I bring with me are second in importance to what is going on with you that day.*"

While nurses at low-attrition sites emphasized participant control over the program as a key component to successful retention, nurses at the high-attrition sites were more likely to emphasize program structure and incentives to participants that occur as a result of involvement in the program. Although nurses at these sites talked about the importance of establishing trust with participants through assuring confidentiality of information shared, they were less likely to describe how the program could be adapted to meet participants' unique needs and goals. The language used by nurses in high-attrition sites suggested that they were less sensitive to participants and their life experiences.

One nurse, for example, explained *"I tell them I expect a call if they cannot make an appointment and that I will call them if I cannot make one. Half of these people do not have a phone. I expect them to get one."* Another nurse related, *"If a mom cannot do four weekly visits in a row, I delay her entering the program until she can."* In explaining the program to participants, one nurse at a high-attrition site said, *"I get some initial information and I leave behind some books; then I tell them about other incentives that occur during the program."*

Moreover, nurses at high-attrition sites seemed to have less insight into why participants might at times appear to disengage from the program and how they could work to re-engage them. As one nurse noted in describing a case where things weren't going well initially, *"I teach mothers how to do things if they do not know how, even teaching them how to clean their house. Some just don't learn this when they are growing up."*

In contrast, a nurse at a low-attrition site related the following story, emphasizing how she learned the importance of demonstrating interest in families and perseverance despite multiple broken appointments:

She wasn't there, she wasn't there, and I tried, and I'd call, and I'd leave messages, and she wasn't responding. So I guess I did that maybe for a month, trying to reschedule, and then decided to back off, and I wouldn't call for a whole month and she wouldn't call...So then I found myself sending her a letter or card if there was a holiday or birthday with message about 'hoping to see you and the baby soon, call me'...And maybe the following month, maybe 3 months already that I haven't seen her, I sent her some handouts with the message 'thought you might find these interesting...read them...I miss you and the baby.' I think it took 4 or 5 months of not pushing and then she called...I made sure I didn't make her feel bad about all the missed visits when I saw her for the first time again...she shared that there had been a crisis in the family—her parents were getting a divorce and she didn't want to deal with anybody at the time.

Another nurse at a low-attrition site related a similar story with a family and summarized that she learned that it was important to recognize nonverbal cues that participants may be stressed or overwhelmed and not to interpret their behavior as indicating lack of interest in continuing with the program. *"Because it is not the issue of they don't want you there – they just have too many things on their mind to deal with..."*

Supervisors at high- and low-attrition sites also appeared to differ in their perceptions of the skills of nurse home visitors who were more or less successful in engaging and retaining clients in the program. Supervisors at low-attrition sites stressed that home visitors who were most successful at engaging and retaining participants in the program were flexible and able to adapt program guidelines to the needs of participants, were good listeners, and willing to look at their own behavior, seek supervision and change their approaches when things were not working. Supervisors at high-attrition sites attributed nurses' success in engaging participants to *"confidence and maturity and some life experience."*

Discussion

Quantitative analyses indicated that higher-risk participants (especially unmarried teens) were more likely to drop out of the program and have fewer completed visits during pregnancy and infancy, probably because increased social disadvantage creates barriers to participation, such as transience, problems with crowded housing, and less consistent family routines (Roggman et al. 2008). African American families had higher and Hispanics had lower rates of attrition. Families visited by nurses who left the program before the child's first birthday were 7.53 times more likely to drop and had 1.72 fewer completed visits, after adjustment for attrition, than their counterparts whose nurses remained employed in the program. Even after adjusting for participant risks, and nurse attrition, there was substantial site-by-site variation in addressable attrition.

The qualitative data elucidated possible origins of the nurse and site variation. Nurses in both high- and low-attrition sites talked about the value of respect, confidentiality, and empathy, but nurses in high-attrition sites put more of the responsibility for engagement on the mothers themselves. Nurses from sites with lower attrition reported adapting the program to the needs and aspirations of the families they visited.

This collaborative, flexible style of interacting with participants may be especially appreciated by higher-risk participants, who are likely to experience uncertainty about where they will be living next week, and other stressors in their lives that can interfere with their having consistent household routines. These results suggest that developing strategies to help nurses empathize more with clients' challenges, and to adapt the program even more completely to their needs may increase retention and number of completed home visits.

Such an approach is consistent with Motivational Interviewing (Rollnick et al. 2008), which emphasizes the importance of collaboration with clients to address issues of concern to them as a foundation for participant engagement and behavioral change. This work raises fundamental questions about the nature of fidelity to evidence-based preventive interventions. It suggests that adaptation to clients' needs is a core competence, consistent with the NFP program model, that may be compromised by nurses' placing too much emphasis on faithful adherence to completing the prescribed number of visits or covering all program content. Focusing on these structural features of fidelity is likely to disregard clients' obstacles to participation, and may not align with their priorities, undermining engagement and the facilitation of adaptive behavioral changes.

As a result of the work reported here, we developed and tested in a quasi-experimental study a retention intervention in which nurses were guided to adapt more completely the program structure (such as visit frequency) and content to the needs of parents and families (Ingoldsby et al. under review). This quasi-experimental study has helped us learn the extent to which this intervention improves retention and completed home visits. It will need to be extended with a randomized controlled trial and additional qualitative work to ascertain its full impact on improving NFP performance in community practice.

The findings of this study must be interpreted in light of its limitations. First, some of the reasons for attrition shown in Table 1 are likely to be imprecise. It is likely, for example, that some of the women classified as "could not locate" simply had moved from the catchment area and did not tell the nurse beforehand.

Second, there are unmeasured characteristics of organizational context (e.g., policies related to reimbursement for visits, degree to which time is set aside for reflective supervision) that are likely to affect nurses' willingness to give greater control of the program content and

scheduling to clients, but we have no quantitative data on these features of organizational context.

Third, we did not assess participant dropout during the child's second year of life. While it is possible that the results of this study may have been different if we had examined attrition in the second year, we have found that the greatest portion of attrition occurs in the first year following the child's birth.

Fourth, a case could be made for using a shorter interval between visits to define operationally those cases that had actually dropped, even though their nurses did not classify them as drops. As noted above, when we employed a 90-day interval to define a drop, the rate of attrition did not increase appreciably. At some point, for those cases not indicated as drops by their nurses, further shortening the intervals between visits to operationally define a drop moves the analysis from a study of attrition to an analysis of adherence to visit schedule, a topic which deserves additional analysis.

Fifth, the study was conducted early in the phases of national implementation of the NFP, and it is possible that the predictors of attrition and completed home visits may have changed in recent years. We plan to examine changes in the predictors of these features of implementation as the NFP serves larger numbers of families over time.

Mothers at greater socio-demographic risk are more likely to drop out of the NFP and to have fewer completed home visits. Sites and nurses differ in their success in retaining families and completing home visits, even after adjustments are made in the risk characteristics of families they serve. Nurses who adapt the program to families' needs and develop a more collaborative style are more likely to retain them and complete a larger number of home visits.

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Table 1

Reasons for and rates of attrition through child age one

Reason for Attrition by Child Age 12 months	Number of Program Drops	Percentage of Cases Dropped by Child Age 12 Months (N = 10,367)
Miscarriage/Still birth	234	2.3%
Infant death	41	0.4%
Maternal death	10	0.1%
Mother lost custody of child	97	0.9%
Moved from catchment area	667	6.4%
Non-Addressable Subtotal	1,049	10.1%
Declined services	1,508	14.5%
Could not locate	713	6.9%
Excessive missed appointments	1,355	13.1%
>180 days without visit ^a	509	4.9%
Addressable Subtotal	4,085	39.4%
TOTAL ATTRITION	5,134	49.5%

^aShortening the interval of days without a home visit to 90 increases the rate of attrition from 4.9% to 7.2%

Table 2

Characteristics of population and univariate predictors of addressable attrition and completed home visits before child age 12 months ($N = 10,367$)

Predictors and (number of valid values) ^a	Population Mean (SD) or %	% Dropped ^b	Attrition Odds Ratio (95% CI)	Completed Home Visits Difference (95% CI)
Participant Characteristics at Enrollment				
Participant age ($n = 10,367$)	19.48 (3.92)	39%	0.77 (0.73, 0.80)	1.25 (1.03, 1.46)
Age 16 years and under	19%	43%	1.24 (1.12, 1.38)	-0.77 (-1.32, -0.21)
Age 17–18 years	29%	43%	1.30 (1.19, 1.42)	-1.63 (-2.10, -1.16)
Age 19 years or older	52%	36%	0.70 (0.64, 0.76)	1.90 (1.46, 2.34)
Participant race/ethnicity ($n = 10,053$)				
Non-Hispanic White	54%	39%	0.99 (0.91, 1.08)	0.57 (0.09, 1.05)
Black	18%	47%	1.45 (1.29, 1.62)	-2.02 (-2.66, -1.38)
Hispanic	13%	31%	0.69 (0.61, 0.80)	1.28 (0.53, 2.03)
Native American	8%	41%	1.01 (0.86, 1.18)	0.28 (-0.57, 1.12)
Other or mixed race/ethnicity	8%	33%	0.83 (0.71, 0.98)	-0.23 (-1.11, 0.65)
Household composition ($n = 9,776$)				
Lives alone	6%	47%	1.24 (1.04, 1.48)	-1.17 (-2.12, -0.22)
Lives with extended family	15%	45%	1.25 (1.12, 1.40)	-1.78 (-2.39, -1.17)
Lives with husband or boyfriend	39%	36%	0.74 (0.68, 0.81)	1.52 (1.07, 1.98)
Lives with mother	41%	41%	1.13 (1.04, 1.23)	-0.28 (-0.73, 0.17)
Household annual income ($n = 9,148$)	14,341 (11,836)	39%	0.93 (0.89, 0.97)	0.68 (0.45, 0.92)
Maternal education				
Years of completed education ($n = 10,063$)	11.12 (2.23)	39%	0.87 (0.83, 0.90)	0.79 (0.56, 1.01)
Completed high school ($n = 9,810$)	47%	37%	0.73 (0.67, 0.79)	1.89 (1.45, 2.33)
Enrolled in school ($n = 9,711$)	38%	42%	1.20 (1.10, 1.30)	-0.57 (-1.02, -0.11)
Mother employed ($n = 9,977$)	37%	37%	0.86 (0.79, 0.94)	1.11 (0.66, 1.57)
Mother married ($n = 10,079$)	26%	31%	0.62 (0.56, 0.68)	2.67 (2.17, 3.18)
Mother received medicaid ($n = 10,101$)	56%	40%	1.16 (1.07, 1.26)	-0.70 (-1.15, -0.24)
Substance Use				
Cigarette smoker ($n = 8,722$)	20%	40%	1.27 (1.13, 1.41)	-1.16 (-1.70, -0.62)
Alcohol, marijuana, and/or other drug use ($n = 8,714$)	3%	32%	0.88 (0.68, 1.13)	0.95 (-0.25, 2.14)
Gestational age in weeks ($n = 10,367$)	18.68 (7.30)	39%	1.02 (0.98, 1.06)	-1.35 (-1.58, -1.13)
Mastery/mental health				
Psychological mastery score ($n = 9,902$)	99.83 (10.08)	40%	1.03 (0.99, 1.07)	-0.20 (-0.42, 0.02)
Mental health score ($n = 9,960$)	99.96 (10.06)	40%	0.99 (0.95, 1.03)	0.18 (-0.04, 0.40)
Nurse Characteristics				
Months of employment in NFP ($n = 10,097$)	8.99 (8.30)	40%	1.07 (1.03, 1.12)	-0.91 (-1.16, -0.66)
Nurse left NFP during pregnancy phase $n = 10,367$	14%	79%	7.77 (6.77, 8.92)	-7.67 (-8.38, -6.96)
Program Implementation				
Attempted but incomplete visits ($n = 8,257$)	1.28 (1.57)	36%	1.65 (1.56, 1.73)	-2.96 (-3.19, -2.73)

Predictors and (number of valid values) ^a	Population Mean (SD) or %	% Dropped ^b	Attrition Odds Ratio (95% CI)	Completed Home Visits Difference (95% CI)
Completed-to-expected visit ratio (<i>n</i> = 10,089)	0.76 (0.32)	40%	0.36 (0.34, 0.38)	6.84 (6.67, 7.02)
Mother's involvement in prenatal visits (<i>n</i> = 10,353)	4.61 (0.56)	39%	0.83 (0.80, 0.87)	1.61 (1.35, 1.88)
% of time in visits spent on personal health (<i>n</i> = 10,366)	38.79 (14.32)	39%	1.08 (1.04, 1.13)	-1.64 (-1.92, -1.35)
% of time in visits on maternal role (<i>n</i> = 10,366)	21.92 (7.49)	39%	0.82 (0.79, 0.86)	2.85 (2.60, 3.09)
Total number of minutes spent in HV (<i>n</i> = 10,365)	77.90 (19.50)	39%	0.93 (0.89, 0.97)	0.11 (-0.13, 0.36)

^aFor categorical predictors we estimate odds ratios and completed home visits for the selected category compared to the remaining sample (e.g., those less than 16 years of age compared to mothers of all remaining ages)

^bFor addressable reasons

Table 3

Mixed multivariate regression model predicting addressable participant attrition and completed home visits ($N = 9,631$)

Predictors ^a	Attrition Adjusted Odds Ratio (95% CI)	No. Completed Home Visits Adjusted Mean (95% CI)
Fixed Effects		
Addressable attrition (y/n)	–	–15.6 ^b (–15.9, –15.3)
Maternal age <= 18 vs. 19+	1.30 (1.17, 1.43)	–0.58 (–0.93, –0.22)
Unmarried (y/n)	1.42 (1.26, 1.61)	–0.61 (–1.04, –0.19)
Lives with mother vs. Alone or with extended family	0.84 (0.75, 0.95)	0.94 (0.51, 1.37)
Lives with Husband/Boyfriend vs. Alone or with extended family	0.86 (0.75, 0.99)	0.67 (0.20, 1.14)
Maternal employment at enrollment - y/n	0.95 (0.86, 1.04)	0.38 (0.04, 0.71)
African American vs. Caucasian, Native American, or Other/Mixed	1.32 (1.16, 1.50)	–0.34 (–0.81, 0.14)
Hispanic vs. Caucasian, Native American, or Other/Mixed	0.81 (0.70, 0.95)	0.40 (–0.14, 0.95)
Gestational age at enrollment (weeks)	1.01 (0.97, 1.06)	–1.80 (–1.96, –1.64)
Nurse home visitor left NFP employment – y/n	7.53 (6.52, 8.69)	–1.72 (–2.26, –1.18)
Home visitor length of employment in NFP (mos.)	1.08 (1.03, 1.13)	–0.01 (–0.19, 0.17)
Random Effects		
	Variance ^c	Variance (%) ^c
Sites	0.12	3.15 (4.8)
Nurses within sites	–	4.54 (7.0)
Residual	–	57.33 (88.2)

^aFor categorical predictors, numbers represent adjusted odds ratios and differences in completed home visits in subgroup versus specified reference subgroup; for continuous predictors, numbers represent adjusted change in completed home visits associated with a 1 SD change in the predictor

^bMean and (standard error) of completed visits for cases without addressable attrition = 26.02 (0.31) and those with addressable attrition = 10.41 (0.31)

^cVariance attributable to random effect for sites with attrition (a dichotomous variable) as the outcome is highly significant ($p < .0001$) with standard error of 0.068; note that analysis of nurses within sites did not converge for attrition. Estimates of random effects for sites and nurses within sites are expressed both as variance estimates and percentage of total variance for completed home visits (a continuous outcome). The random effects for sites and nurses within sites are highly significant ($p < .0001$) for completed home visits

Table 4

Interview questions for nurse home visitors

1	<p>Tell me about how you approach developing relationships with the NFP participants assigned to you? To help me really understand what you mean, think of the participant you enrolled most recently and describe how you approached developing the relationship.</p> <p>Probe: Do you think you use different approaches with participants from special populations? Teens? Participants who may be cognitively impaired? Those who are fairly educated? And are there any special considerations you give to working with participants whose racial/ethnic background differs from yours?</p>
2a	<p>How do you know when a mother is actually engaged with you?</p> <p>Probe: How does the mother behave toward you during visits? Can you describe for me some case examples?</p>
2b	<p>Following a home visit with a family, you are asked to rate the involvement of the mother and other family members in the visit on the Home Visit Encounter Form using a scale of one to five. Describe for me the behavior of a mother or other family members that would lead you to give a rating of one? A three? A five?</p>
3	<p>What clues do you think give you the sense that a mother might leave the program?</p> <p>Probe: To help me understand what you mean, think about a specific mother in your caseload who has dropped from the program and describe your relationship with her. How did the relationship begin? About when (# visits) did you begin to sense that things were not going well? What were her behaviors during visits?</p>
4	<p>Can you describe a case where things weren't going well, but you were able to turn things around over time? How did you get that to happen?</p> <p>Probe: What clues gave you the sense that your relationship with the mother was improving?</p>
5	<p>If you were coaching a new home visitor, what would you tell her/him were the most important things to do in developing relationships with mothers?</p>

Table 5

Interview questions for nurse supervisors

1	What relationship issues with their NFP families have home visitors raised in supervision with you? Probe: Can you describe a couple of case situations to help me understand the issues better?
2	What traits or skills do you feel are characteristics of those nurse home visitors who are most successful at engaging and retaining participants in the program? Probe: Think of a specific nurse home visitor and participant and describe that situation to me.
3	What traits or skills do you feel are characteristics of those nurse home visitors who are struggling most to engage and retain participants in the program? Probe: Think of a specific nurse home visitor and participant and describe that situation to me.
4	Think of a case where things were not going well between a home visitor and a family, but then somehow the home visitor was able to turn things around and really get the family involved in the program. Can you describe to me what you think the visitor did to get that to happen?