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Visit Attendance Patterns in Nurse-Family Partnership Community Sites

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Abstract

Objectives—We examined visit attendance patterns of mothers enrolled in the Nurse-Family Partnership (NFP) home visitation program and associations between these patterns and characteristics of the families and sites, with the goal of increasing participant engagement.

Methods—We utilized repeated measures latent class analysis to identify attendance patterns among 66,967 mothers in NFP sites across the United States. Mothers enrolled from 1996 to 2010. Data were collected by home visitors and aggregated by the NFP National Service Office.

Results—Five visit attendance patterns were identified. Consistent attenders (22%) remained engaged for the full program and attended 51.3 visits on average. Inconsistent attenders (9%) remained engaged, but missed many visits, with an average of 36.4 visits. The remaining patterns were characterized by when participants left the program: early (28%; 6.7 visits), gradually (27%; 19.4 visits); or late (15%; 35.3 visits). Consistent and inconsistent attenders were less likely to use English as their primary language than other participants ($R=.12$; $p<.001$). Participants with more nurse changes per visit attended were more likely to drop out early ($R=.11$; $p<.001$). Sites with a

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Compliance with Ethical Standards

Disclosure of potential conflicts of interest

The Prevention Research Center for Family and Child Health, directed by Dr. Olds at the University of Colorado School of Medicine, has a contract with the Nurse-Family Partnership (NFP) to conduct research to improve the NFP program and its implementation. Dr. Olds was employed by this center at the time the study was conducted. Dr. Olds is the founder of the NFP.

Ethical approval

This study was approved by the University of Rochester Research Subjects Review Board. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

All program participants provide consent for their data to be used for purposes of program improvement.

higher percent of missing data had smaller portions of mothers who remained consistently engaged in the program over time ($b=-0.032$; $p<.01$) and greater portions in the late ($b=0.007$; $p<.04$) and gradual attrition classes ($b=0.018$; $p<.01$).

Conclusions—The large number of participants who dropped out early is concerning. Further exploration of this group may optimize use of resources, by improving either retention or targeting of potential participants.

Keywords

Home visiting; attrition; retention; dose

Retention is a common problem in home visiting programs for new mothers (Ingoldsby et al., 2013; O'Brien et al., 2012; Raikes et al., 2006; Wagner, Spiker, Gerlach-Downie, & Hernandez, 2000). Missed visits and attrition are important because they reduce program dose, which is associated with lower effectiveness (Raikes et al., 2006). Previous work with research trial data from several programs found associations between patterns of engagement, intake characteristics, and outcomes (Baker, Arnold, & Meagher, 2011; Coatsworth, Duncan, Pantin, & Szapocznik, 2006; Holland, Xia, Kitzman, Dozier, & Olds, 2014).

Program retention rates achieved during research trials are often not sustained in wider implementation. When programs are expanded from research sites to community settings, additional challenges to retention are encountered (Bumbarger & Perkins, 2008; Paulsell, Del Grosso, & Supplee, 2014), including fewer staff resources to reach out to participants, and fewer financial incentives for mothers to engage in data collection. To our knowledge, visit attendance patterns have not been studied in home visiting after implementation to community settings, although predictors and participant retention have been examined (O'Brien et al., 2012).

The Nurse-Family Partnership (NFP) is a home visiting program for first-time, low-income, new mothers. Nurses visit families from pregnancy through the child's second birthday. The program is based on a model tested in three randomized clinical trials (Kitzman et al., 1997; Olds, Henderson, Tatelbaum, & Chamberlin, 1986; Olds et al., 2002). Nurses work with mothers and families to achieve three major goals, to improve: 1) the outcomes of pregnancy by helping women improve their prenatal health; 2) children's subsequent health and development by helping parents provide competent care; and 3) women's own health and self-sufficiency by helping them set goals for themselves and take steps to accomplish those goals, including planning the timing of subsequent pregnancies (Olds, Hill, O'Brien, Racine, & Moritz, 2003). Based on positive findings in these trials, NFP was implemented across the United States beginning in 1996 (Nurse-Family Partnership, 2015). Evidence from the NFP trials contributed to the inclusion of funding for maternal and infant home visiting in the Affordable Care Act of 2010 (Haskins, Paxson, & Brooks-Gunn, 2009). The NFP National Service Office (NSO) provides support and training to NFP sites to ensure fidelity to the model, and monitors program implementation and outcomes to serve as a foundation for quality improvement.

Visit attendance patterns were examined in a research trial of the NFP (Holland, Xia, et al., 2014). In this trial, attrition was 27%. Three patterns were identified: high attenders (60% or more of visits attended during each time-period), low attenders (less than 60% of visits in all but one time-period), and increasing attenders (low attendance early in the program, but high later). These patterns were associated with improvement in outcomes, including subsequent pregnancy spacing and the children's math achievement. Replicating this work in community sites is important, because attrition rates are substantially higher outside of research settings: 60 to 70% based on information from the same database as our sample (O'Brien et al., 2012).

In a study of home visiting delivered through a center-based preschool program, three visit attendance patterns were also identified: perfect attenders (no missed visits), dropouts (no more visits after one missed), and mixed attenders (some missed visits, but returned after a missed visit) (Baker et al., 2011). A third study, from a parenting program for parents of middle-school parents, identified three similar patterns: consistently-high attenders (>60% of visits), variable attenders (<60%), and non-attenders (no visits) (Coatsworth et al., 2006).

Previous investigations examined factors associated with attrition from home visiting programs. Increased attrition was associated with lower socioeconomic status (Brand & Jungmann, 2014; O'Brien et al., 2012), unemployment (Foulon et al., 2015; O'Brien et al., 2012), better mental health (Foulon et al., 2015; Goldberg, Bumgarner, & Jacobs, 2016; Holland, Xia, et al., 2014), a change in home visitor (O'Brien et al., 2012), and no substance abuse (Barlow et al., 2015). Lower socioeconomic status and unemployment may be indicators of family stress that make prioritizing home visits difficult, while other risk factors make those same visits important and worth making the effort to attend. To some degree, this is likely to depend upon the purpose and structure of the visits. Other factors have been inconsistently associated with attrition, including: maternal age (Brand & Jungmann, 2014; Holland, Xia, et al., 2014; O'Brien et al., 2012), smoking (Barlow et al., 2015; Foulon et al., 2015; O'Brien et al., 2012), race/ethnicity (Goldberg et al., 2016; O'Brien et al., 2012), being enrolled in school (Foulon et al., 2015; Goldberg et al., 2016; O'Brien et al., 2012), education (Holland, Xia, et al., 2014; O'Brien et al., 2012), and living with a partner (Goldberg et al., 2016; O'Brien et al., 2012). In cases of inconsistent findings, the definitions of attrition and/or the predictor were often inconsistent. Differences in the home visiting programs themselves may also have contributed to some of these inconsistencies. For instance, some programs may focus more on the infant, while others may focus more on the family unit.

Because many previous studies were conducted within a single site, little is known about predictors of attrition at the site level; inclusion of these predictors may be important, especially if site-level predictors include policies that can be changed. Moreover, most of the studies cited above focused on overall attrition, not trajectories of visit attendance. Trajectories may distinguish groups of mothers with similar numbers of visits, but different underlying mechanisms. Therefore, the predictors for these groups may be different.

Because visit attendance is a form of health care utilization, Anderson's Behavioral Model of Health Services Use (Andersen, 1995) was chosen to guide this study. This provides a

framework for predictors of health behavior (visit attendance), including characteristics of the environment (site characteristics) and population (demographics, psychological characteristics, health beliefs, personal resources, community resources, health).

The purpose of this study was to examine visit attendance patterns in NFP sites across the United States during its first five years of national community replication. Based on the studies described above, we hypothesized that greater power in the large sample of community sites would allow identification of more classes and that one of the additional classes would be characterized by early attrition, based on the higher levels of attrition in community sites compared to research sites. We hypothesized that these patterns would be associated with maternal and site characteristics at both the participant and the site levels.

METHODS

Participants

For this study, the NFP NSO provided data on 84,868 participants who were enrolled in NFP from 1996 – 2010. All mothers enrolled in NFP before the 28th week of pregnancy and had no previous live births. All were low-income (usually marked by Medicaid eligibility). The recommended frequency of visits varied over time: the first 4 visits were weekly, the remainder of the pregnancy visits were every other week, the first 6 visits after the child's birth were weekly, and then visits were to be scheduled every other week until the last 4 months when visits were once per month (Olds et al., 2003). However, nurses were encouraged to adjust visit schedules to mothers' and families' needs and ability to participate.

For these analyses, families with completely missing demographic data ($n=5,657$) were excluded from the primary analysis, although we examined their visit patterns separately. We also excluded families who left the program for reasons that were largely outside of the program's immediate influence: mothers moved out of service area ($n=10,760$) or were incarcerated ($n=37$); the fetus or child died ($n=1,989$); or the mother died ($n=43$). The final sample size was 66,967 from 111 sites. We examined the group that moved from the program catchment area because this group was sufficiently large to reliably estimate its characteristics.

Measures

Each NFP site collects data on participants based on a standardized set of forms. The measures gathered were based on those used in the research trials. Data on every completed and attempted visit were recorded and submitted to the NFP NSO. Data on maternal demographics, psychological characteristics (sense of mastery), physical health (birth outcomes), and behavioral health (substance use, drinking, depression) were collected at enrollment by the home visitor, using self-report from the participant. For a full list, see Table 1.

Anderson's Behavioral Model and previous literature on attrition in home visiting, especially related to NFP (Holland, Xia, et al., 2014; O'Brien et al., 2012), drove the selection of variables. This framework led to the inclusion of several measures that have

previously been found not to be associated with attrition, but are theoretically relevant, such as mother's self-reported mastery (Holland, Xia, et al., 2014; O'Brien et al., 2012). Given our large sample size, we had sufficient power to include many covariates and therefore included all available measures that fit within the model or were supported by the literature. Maternal depression was not used, because data were available for few participants. Substance use (smoking, drinking, and illegal drugs) had substantial rates of missing data (13%, 13%, and 25%, respectively), which we believe were not randomly missing; therefore, these variables were excluded from the multivariate models and imputation. However, we included them in the descriptive statistics.

Because many of the participants were 18 or younger, we measured education as "on track for age," meaning whether or not she was in the expected grade level in school if she was 18 or younger, or if she had completed high school if she was over 18. We also included a dichotomous measure of education, completing Grade 11, to indicate a level of accomplishment; we did not use the more typical Grade 12, because of the young average age of the participants.

Participant involvement in visits was rated by NFP nurses after each home visit, on a scale of 1 to 5 (1 = "little interaction with home visitor"; 5 = "involved in entire visit, very interested in program content, actively involved in visit"). We included this feature of program implementation because earlier work indicated that program disengagement was predicted by nurses' ratings of participant involvement in the visits, and because a perceived lack of fit between program content and participant needs contributes to attrition (Brand & Jungmann, 2014; Holland, Christensen, Shone, Kearney, & Kitzman, 2014; O'Brien et al., 2012).

We examined the association between birth outcomes and visit patterns because mothers of low-birthweight babies are more likely to perceive their babies as vulnerable and nurses as able to help them address that vulnerability. Very-low-birthweight babies are especially vulnerable, and were therefore examined as a separate category.

Site characteristics were reported to the NSO by the site program directors. Several site-level rules were included to determine if policies affected attrition: caseload size rules and visits allowed on evenings or weekends. The site geographical area was characterized by the percentage of the area served that was rural. The year the site first enrolled participants was used to indicate when the site began, and years operating at the time individual participants enrolled indicated the site's experience at that point in time. The number of mothers enrolled in the same year is an indication of the size of the site. We examined the percent of observations that were missing the discharge reason as a possible proxy for site-level organization.

Attendance Patterns

Visit attendance patterns were identified using repeated measures latent class analysis, which allows the identification of groups of observations with similar patterns based on categorical variables (Collins & Lanza, 2010). Continuous models are also available, but these require assumptions of a functional form (i.e., quadratic or cubic), which are not likely to accurately

describe visit attendance patterns. To create appropriate variables for this method, the length of the program was divided into 9 time-periods (Figure 1). Nine was the largest number of time periods that could be supported. Time-periods were defined to be as equally distributed as possible, with recommended visit frequency constant within each period.

Each time-period provided an indicator for class membership. The percentages of recommended visits attended in each time-period were calculated comparing the number of recommended and actual attended visits. The second time-period varied in length, because it began following four weekly visits after enrollment and continued until the child was born; therefore, the recommended number of visits was one per each full 14-day period. The indicators of visit attendance patterns were attending more than 50% of recommended visits vs. less than or equal to 50%. We chose 50% as the cutoff, because this represents a minimal level of consistent engagement and is consistent with a similar study (Holland, Xia, et al., 2014). Moreover, participants in the original NFP trials attended approximately 50% of the structured visits in the first two trials (Olds, et al., 1997; Kitzman, et al., 1997) and 43% in the third trial (Korfmacher et al. 1999). The PROC LCA macro for SAS was used for these analyses (Collins & Lanza, 2010).

We did not assume that visit patterns were similar across sites, because other factors vary substantially among sites, such as organizational auspices and duration of program operation (Ingoldsby et al., 2013). To address potential differences among sites, we compared models with and without a constraint that the patterns were the same. The difference in model fit between these “constrained” and “unconstrained” models was then tested. Only sites with 200 or more participants were used when comparing these models, because smaller sites may not have sufficient sample size to reliably characterize visit patterns within sites.

Due to the large number of participants in these analyses, we employed several methods to determine whether differences were both statistically and clinically meaningful. In the case of the number of classes identified, we examined the patterns to determine if additional classes could be interpreted as distinct from the classes in the model with fewer classes and also if there was a sufficiently large percentage of the sample (>1%) in each additional pattern to be meaningful. We also randomly selected a sample of 1,000 participants, which allowed us to obtain meaningful model fit statistics including Akaike Information Criterion (AIC) and adjusted Bayesian Information Criterion (BIC), to guide the choice of how many classes.

Associations between Attendance Patterns and Participant & Site Characteristics

We examined participant and site characteristics by attendance class. Given the large sample size, we chose not to identify characteristics that varied among classes using tests of statistical significance, because they almost all were different with $p < .001$ (two exceptions noted in Table 1). Instead, we identified meaningful differences based on effect sizes, using a cutoff of .10. We estimated effect sizes using linear and logistic regression R^2 and pseudo- R^2 . Because there were missing data for up to 10% of sites, we utilized multiple imputation with chained equations (Royston, 2005) with 20 imputations. PROC LCA does not support imputation for covariates, so models using imputed data were analyzed using Stata.

We used a generalized linear model to test associations between site characteristics and visit attendance patterns at the site level. We could not use the LCA model for this analysis, because we were working at the aggregated site level, not the individual level. We calculated the average probabilities of class membership by site and examined which site characteristics were associated with these probabilities. As in the participant-level analysis, we included variables with effects sizes over 0.10 in our model. In the case of highly correlated variables (continuous birth weight, categories of low birth weight), the variable that could be more helpful for predicting future patterns or clinical practice (low birth weight vs. not) was retained. For site-level analyses, we used 0.05 significance level because our sample size was moderate ($n=111$).

RESULTS

Table 1 shows visit participant and site characteristics for the sample as a whole and for those who fell into different attendance pattern classes. Overall, 47% of participants remained in the program until the child was 24 months old (Table 1). The mean number of visits was 26 (range: 1 to 119). One quarter of the sample had 10 or fewer visits; 10% had 3 or fewer.

Attendance Patterns

Given the large sample size, more classes were supported by model fit statistics than were meaningful, and are not reported. In a 7-class model, one class had less than 1% of the sample, which is unlikely to be meaningful. We examined the class structure for a smaller, randomly selected sample ($n=1000$) and found that adjusted-BIC supported 5 classes and AIC supported 6 or 7 classes (Supplemental Table 1, available online). Therefore, we compared the 5- and 6-class model. The additional class in the 6-class model was not substantially different from other classes. Therefore, we chose the 5-class model for the remaining analyses.

We also examined variation of class structure among sites. Again, statistical tests were not helpful due to the large sample size. We examined 73 sites with at least 200 participants ($n=61,839$). Each site had (1) a consistently high class, (3) a consistently low class, (4) an early gradual dropout group, and (5) a later gradual dropout class. The final class (2) was more variable across sites, but generally consisted of participants who missed many visits during the program, but remained engaged. We concluded that there was not a meaningful difference among class structures among sites, and therefore used models constraining the structure to be the same; the proportion of participants in each class varied by site.

The five visit attendance classes identified are shown in Figure 1. Class 1 participants were consistent attenders (mean 51.3 visits). Class 2 participants were inconsistent attenders, varying from attending 41 to 80% of the recommended visits (mean 36.4 visits). Class 3 participants dropped out late and attended less than 20% of recommended visits between 15 and 24 months (mean 35.3 visits). Class 4 had a gradual decline of visits until having very few visits after 12 months (mean 19.4 visits). Class 5 participants were early dropouts (mean 6.7 visits).

We repeated the analyses excluding 3 subsets of sites to determine if they were driving the visit attendance patterns: (1) sites with fewer than 50 participants, (2) two states with implementation challenges due to rapid NFP expansion, and (3) all but the four largest states. The patterns were essentially the same and had only slightly different distributions of participants by class. Excluding the two states with implementation challenges resulted in a higher percentage of consistent attenders (26%) and lower percentage of early dropouts (22%).

Participant-Level Associations between Attendance Patterns and Participant & Site Characteristics

Participants in Classes 1 and 2 were less likely to use English as their primary language (effect size: $R=.12$). Participants with the smallest babies ($R=.12$ for birth weight in grams, $R=.16$ for low birth weight, $R=.12$ for very low birth weight) were more likely to be in Classes 2 and 5. However, higher gestational age at delivery was associated with earlier attrition ($R=.18$). Participants were more likely to drop out early if they were visited by more different nurses per visit attended compared to fewer nurse changes per visit ($R=.11$). Early drop out (Class 5) was also associated with fewer total nurses ($R=.17$), likely due to the smaller number of visits. Class 1 and 2 participants were more likely to be enrolled in a later year of implementation ($R=.10$).

Although the class structure was the same among sites, the distribution of participants in each class varied (Figure 2). Six to 48% of participants in each site were in Class 1. Class 2 varied from 2 to 20% of participants by site. Sites with more Class 5 also had more Class 4 participants, and fewer Class 1, 2, and 3 participants ($p<.05$). Sites with more Class 4 participants had fewer Class 1 and 2 participants ($p<.05$). No other relationships were significant.

Site-Level Associations with Attendance Patterns and Participant & Site Characteristics

Data were collapsed to the site level to determine whether site characteristics were associated with site-level attendance patterns. Ten characteristics had effect sizes greater than .10 and therefore were included in the multivariable models (Table 2). Controlling for other variables, sites with more Black participants were likely to have more participants in Classes 4 and 5 and fewer in Class 1. Sites with participants with higher average mastery scores were likely to have more Class 5 participants and fewer in Class 2. Sites with more low birth weight babies were likely to have more Class 1 participants and fewer Class 5. Sites with more very low birth weight babies were likely to have more Class 3 participants and fewer Class 4. Sites with more missing data had fewer Class 1 participants and more in Classes 3 and 4.

Examination of missing data

Participants who moved attended an average of 12.5 visits (SD: 12.3; range: 0 to 76) before leaving the program and were engaged for an average of 274 days (range: 0 to 987). Supplemental Table 2 (available online) shows that the participants who moved were not substantially different at baseline than those who remained within the service area.

Participants who had no available demographic information attended an average of 22.5 visits (SD: 15.4; range: 1 to 73) and were engaged for an average of 442 days (range: 0 to 1018). They also followed visit attendance patterns that were similar, but not identical to, the full sample. Four attendance patterns were the same: Class 1 (14%), Class 3 (18%), Class 4 (29%), and Class 5 (26%). The remaining 13% followed a pattern of increasing visits.

DISCUSSION

Five visit attendance patterns were identified in community sites of NFP. In two patterns, participants remained engaged throughout the program: consistent attenders who attended most recommended visits and inconsistent attenders who missed visits along the way, but remained in the program. The other three patterns were characterized by participants who dropped out during different stages. Examining these patterns, instead of simply the total number of visits attended or the time to dropout, allowed us to differentiate groups that otherwise would have appeared to be the same. We identified participant and site characteristics that predicted pattern membership.

Class 1 participants were more likely to have need for support, as indicated by primary language, and were likely to be in more established sites with good organization (low missing data) and sites that had other participants who needed more support, as indicated by low birth weight. Class 2 participants were similar, but their sites had average organization and more participants with lower mastery. Classes 3 and 4 were more likely to be at larger sites with poorer organization. Early nurse changes were more likely for Class 5 participants, and these participants were at sites with more Black participants. These findings combine to suggest that site organization and a stable home visitor work force predict higher participant retention.

The participant- and site-level models identified somewhat different sets of characteristics associated with attrition. This is likely because the visit attendance of an individual participant is primarily due to her own priorities and challenges, but also impacted by her site. Birth weight was a significant factor on both levels, although low birth weight was associated with individuals being *more* likely to miss visits, whereas sites with more low birth weight babies had participants who were *less* likely to miss visits. In addition, lower gestational age was associated with individuals being *less* likely to miss visits, which is inconsistent with the individual-level birth weight finding, given the expected correlation with birth weight. On the participant level, it may be that low birth weight was associated with medical problems that required more follow up medical care that competed for time with home visits or other health risk factors that resulted in trouble attending visits. Lower gestational age may be associated with participants feeling that their infants are more vulnerable, and therefore in greater need of the program. The inconsistency with birth weight may indicate different subgroups within these classes. On the site level, a higher rate of low birth weight suggests a population with greater disadvantage; some sites may rise to this challenge, if they have sufficient resources. The association may also be explained by site characteristics that were not measured, but may be correlated with each other, such as recruitment (resulting in participants at higher risk for low birth weight), site processes (to manage and retain these challenging cases), or exceptional supervisors (who supported

recruitment and retention). These findings may help sites identify participants at risk for dropping out and in need of additional support and flexibility to help them stay engaged.

Participants who did not speak English as their primary language were more likely to remain engaged and attend visits, perhaps because they had greater need for assistance in navigating health and social services. This is contrary to other findings that have found Latina mothers to be less likely to use prenatal care due to mistrust of health services and fear of immigration enforcement (Rhodes, et. al, 2015), assuming that primary language is associated with immigration status. NFP may be different because of the focus on relationships early in the program and visits in the home, where others are not present to question immigration status.

Greater attrition in sites with more Black mothers is consistent with previous literature on attrition rates of racial minorities. This finding suggests that it may be appropriate to provide additional resources to these sites with large portions of Blacks in attempts to further understand and improve retention.

Higher average mastery at the site level was associated with dropping early, which is consistent with previous findings that some low attending mothers may leave early because they do not require the support and resources the program provides (Holland, Xia, et al., 2014). The association between low average mastery and inconsistent attendance may be an indication that the lower sense of control translates to greater difficulty being consistently available for visits, but a need for the program that helps these mothers remain engaged. Home visitors may want to provide flexibility in scheduling, and perhaps less frequent visits, to those with high mastery, in order to be available for support and questions as needed, but not require more visits than may be necessary for these participants. On the other hand, participants with low mastery may need additional support to manage their schedules and communicate with their home visitor to successfully remain engaged in the program. Mothers with higher levels of mastery and psychological resources completed fewer visits in the first two trials of the NFP, with good maternal and child outcomes (Olds and Korfmacher, 1998).

Missing discharge reason was associated with greater attrition at both the participant and site levels, which is consistent with the measure acting as a proxy for a site organization. The association between nurse changes and less participant engagement is consistent with previous findings (O'Brien et al., 2012). Smaller sites and those that had been operating for a shorter time had better engagement, perhaps because they were building caseloads and had more time to locate mothers to retain in the program.

Two of the visit patterns we identified were similar to patterns identified in the NFP research trial conducted in Memphis (Holland, Xia, et al., 2014). The consistent attender patterns were comparable. Inconsistent attenders in the community sites were similar to low attenders in the Memphis trial, with many missed visits but continued engagement throughout the program. The Memphis trial had a third pattern not evident in the national dataset: increasing attendance. This pattern was, however, present for participants who were missing demographic data. This suggests that there may be a subset of participants who

follow this pattern, but our overall analyses were unable to characterize them because of missing data. The remaining community site patterns, not evident in the research trial, all involved decreasing visit attendance, which are consistent with previous work (Baker et al., 2011; Coatsworth et al., 2006).

These analyses do not provide information regarding the reasons for these patterns, but we know that different support structures and resources exist between research trials and community settings (Bumbarger & Perkins, 2008; Paulsell et al., 2014). Agreeing to be in a research trial may be a different decision process than agreeing to participate in a home visiting program. Research participants typically receive honoraria at different time points for data collection. Although these honoraria are not directly linked to program participation, they may encourage participants to stay engaged in the program. In research, more resources may be available to find and engage those who start missing visits. Research trials recruit participants over a certain time-period, and then work with those participants. In the community settings, recruitment is ongoing and some sites have waiting lists, meaning that discharging a participant who is not engaged may allow a new participant to enroll, which may impact these decisions.

The high rate of early drop out is concerning because these mothers receive a lower intervention dose. Fetal and child deaths do not contribute to the early dropouts shown here, because they are were excluded. The large percentage of participants who dropped out very early may indicate that some participants enroll without fully understanding the program or ensuring that their needs align with what the program offers. Also, nurses in community replication sites were required to collect more data during visits than nurses did in the original trials, which may have interfered with their formation of a relationship with the mother during early visits. Participants at greatest risk for attrition are more likely to be transient or homeless: we know from qualitative work on participant attrition that one of the factors contributing to attrition is the mother's discomfort in accepting visitors into the (often temporary) homes of others where they are guests (Holland, Christensen, et al., 2014). A retention intervention for NFP sites was implemented after the data analyzed in this study were collected, and some sites have been less successful in integrating this intervention into their practice (Olds et al., 2015). We are now examining the following questions with the goal of increasing retention – especially among those at greatest risk: Is the NFP program reaching more homeless, or near-homeless, mothers today than earlier? Is full implementation of the retention intervention associated with lower attrition? What are the characteristics of sites with high and low rates of early attrition, and can understanding those characteristics reduce the rates of early participant attrition?

Study Limitations

This study was limited to a single home-visiting program, so findings cannot be generalized to other programs. Using these administrative data, we cannot draw any conclusions about why individuals follow specific visit attendance patterns. However, knowing that these patterns exist can aid local programs and the NFP national office in considering how to optimize client engagement. Although this is an evidence-based program and consistent engagement is likely to result in the best outcomes, it is important to note that nurses

adjusted visit dosage in the original trials of the NFP to meet families' needs (Holland, Xia, et al., 2014; Olds & Korfmacher, 1998). From our findings, we do not know if those who dropped out early did so because they realized they did not need it or if they left because their lives were too challenging to manage staying involved, but we suspect that both of these groups were represented.

The large dataset available for this study allowed an in-depth examination of visit attendance patterns and associations with participant and site characteristics across those enrolled in the NFP. Future research should determine if visit attendance patterns are associated with maternal and child outcomes in community replication, as they were in the research trials. Future research should also include sensitivity analysis around the selection of the cutoff level for creating attendance pattern indicators. We chose 50% based upon previous work and our understanding of the program, but other values may be valid and yield different conclusions.

Implications & Conclusions

These analyses identified patterns of visits attendance and factors associated with early attrition from NFP across many sites nationally. Understanding these patterns may help sites more proactively respond to the needs of their participants by prioritizing retention efforts to those with identified risk factors. The national NFP NSO may use these findings to target support for sites at risk for high attrition and local sites may also choose to examine their own rates of early drop out to invoke quality improvement to reduce early attrition, especially among participants with indications of high risk.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Average visits attended by each class from enrollment to 24 months. Figure 1a shows the 5-class model, with 9 time periods, which was used for the analyses in this manuscript. Figure 1b shows a 3 class model with 6 time periods to allow comparison to the research trial visit attendance patterns previously reported. (Holland, Xia, et al., 2014)

^aTime periods were: [1] first 4 weeks in the program (weekly visits), [2] remaining weeks until birth (visits every 2 weeks), [3] first 3 weeks after birth (weekly visits), [4] 4 to 6 weeks (weekly visits), [5] 7 weeks to 6 months (visits every 2 weeks), [6] 6 to 12 months (visits every 2 weeks), [7] 12 to 18 months (visits every 2 weeks) [8] 18 to 20 months (visits every 2 weeks), [9] 21 to 24 months (monthly visits).

^bPercentage of sample in this class.

Figure 2.

The proportion of participants in each class is illustrated for sites with 200 or more participants. The sites are ordered along the x-axis by the total number of visits completed.

Table 1

Description of sample (N=66,967 patients in 205 programs) by visit attendance class. All effect sizes are significant ($p<.001$), except as noted (n/s).

	Full Sample	Class 1 “consistent”	Class 2 “inconsistent, don’t drop”	Class 3 “drop late”	Class 4 “gradual decline”	Class 5 “drop early”	Effect Size (R^2)
<u>Characteristics at Enrollment</u>							
American Indian	10%	9%	9%	9%	10%	12%	.06
Asian	2%	3%	3%	2%	2%	1%	.07
Black	28%	28%	28%	27%	32%	28%	.08
Native Hawaiian	2%	3%	3%	2%	2%	1%	.07
White	61%	61%	61%	61%	56%	59%	.07
Hispanic	24%	30%	30%	25%	24%	19%	.06
English is primary language	85%	80%	80%	85%	86%	90%	.12
Lives alone	4%	4%	4%	4%	4%	4%	.03 (n/s)
Married	17%	19%	19%	18%	15%	15%	.08
Sees father of baby ever	88%	88%	88%	88%	88%	89%	.03
Sees father of baby daily	71%	72%	72%	70%	69%	72%	.03
Grade 11 completed	65%	65%	65%	65%	63%	65%	.04
Education on-track for age ^b	79%	80%	80%	81%	79%	78%	.03
Highest grade completed	10.9	10.9	10.9	10.9	10.8	10.9	.05
Employed	45%	45%	45%	46%	43%	43%	.03
Income – household							.05
\$6,000	27%	25%	25%	25%	28%	31%	
\$6,001 – \$12,000	21%	20%	20%	21%	21%	22%	
\$12,001 – \$20,000	25%	28%	28%	25%	24%	24%	
\$20,001 – \$30,000	15%	15%	15%	16%	14%	13%	
\$30,001 – \$40,000	6%	6%	6%	7%	6%	5%	
\$40,000	6%	5%	5%	6%	6%	5%	
Age							.07
<17	19%	18%	18%	20%	21%	18%	
17 or 18	27%	26%	26%	25%	30%	31%	
>18	54%	56%	56%	55%	49%	52%	

	Full Sample	Class 1 “consistent”	Class 2 “inconsistent, don’t drop”	Class 3 “drop late”	Class 4 “gradual decline”	Class 5 “drop early”	Effect Size (R ²)
Mean age (years)	19.7	20.0	20.0	19.7	19.2	19.3	.08
Mean mastery score ^c	100.0	99.6	99.6	100.0	100.0	100.4	.03
Mean weeks pregnant when prenatal care began	9.2	9.0	9.0	9.2	9.4	9.0	.04
Smoke during pregnancy	16%	14%	14%	15%	16%	18%	.05
Drink during pregnancy (past 14 days)	1%	1.3%	1.2%	1.1%	1.1%	1.2%	.02 (n/s)
Use illegal drugs during pregnancy (past 14 days)	0.2%	0.1%	0.1%	0.2%	0.3%	0.2%	.096
<u>Birth outcomes</u>							
Mean birth weight (g)	3185	3207	3149	3198	3181	3129	.12
Mean gestational age at birth (weeks)	39.1	38.9	38.8	38.9	39.0	39.7	.18
Mean days in neonatal intensive care unit	1.4	1.3	2.0	1.3	1.2	1.8	.03
Low birth weight (% <2500g)	9%	9%	11%	9%	9%	12%	.16
Very low birth weight (% <1500 g)	1.1%	1.1%	2.1%	0.9%	0.9%	1.4%	.12
<u>Mother’s program history</u>							
Mean days from enrollment to discharge	605	870	861	747	478	238	.86
Mean days from enrollment to child’s birth	143	143	140	140	137	151	.12
Mean total number of visits	26	51	36	35	18	6	.95
Number of nurses who visited	1.27	1.43	1.47	1.39	1.25	1.10	.17
Nurse changes per visit	0.012	0.0085	0.013	0.011	0.013	0.013	.11
Number of nurses who visited in prenatal period	1.08	1.09	1.10	1.10	1.09	1.06	.07
Nurse changes per visit prenatal	0.010	0.0088	0.012	0.0096	0.011	0.011	.07
Mother involvement in visits – all visits ^d	4.60	4.62	4.59	4.61	4.59	4.59	.03
Mother involvement in visits – pregnancy ^d	4.65	4.69	4.65	4.68	4.65	4.61	.07
<u>Discharge reason</u>							
Child reached 24 months (graduated)	47%	98%	93%	49%	13%	4%	.79
Client received what she needs from the program	2%	0.1%	0.4%	3%	4%	4%	.30
Client returned to work or school	3%	0.1%	0.4%	4%	7%	4%	.33
Dissatisfied with program	0.2%	0.0%	0.0%	0.1%	0.2%	0.4%	.28
Pressure from family	0.4%	0.0%	0.0%	0.3%	1%	1%	.29
Refused new nurse	2%	0.2%	0.3%	4%	3%	1%	.29

	Full Sample	Class 1 “consistent”	Class 2 “inconsistent, don’t drop”	Class 3 “drop late”	Class 4 “gradual decline”	Class 5 “drop early”	Effect Size (R^2)
Excessive missed appointments/ attempted visits	20%	1%	3%	17%	33%	39%	.46
Unable to locate	25%	1%	3%	23%	39%	47%	.49
Site Characteristics							
Visits can be held on evenings and weekends	53%	53%	55%	51%	52%	53%	.03
<u>Caseload rules</u>							.05
Caseload rule must be exactly 25 families	30%	36%	32%	30%	29%	25%	
No caseload rule	18%	19%	18%	18%	18%	16%	
Caseload rule allows fewer than 25 families	21%	20%	20%	21%	21%	21%	
Caseload rule allows more than 25 families	32%	26%	30%	31%	33%	37%	
Percent of site area that is rural	23%	24%	21%	23%	23%	24%	.06
Mean year site first enrolled mothers	1999.9	2000.3	2000.3	2000.0	1999.9	1999.5	.10
Mean number of mothers enrolled in the same year as the observed mother	115	98	96	115	120	126	.10
Mean number of years the site was operating at mother’s enrollment	4.1	4.0	3.9	4.0	4.1	4.6	.09
Mean mother’s enrollment year	2004.0	2004.3	2004.2	2003.9	2004.0	2004.1	.04
Percent of observations missing discharge reason	23.8%	22.7%	23.1%	23.9%	24.1%	24.6%	.10
Percent of observations missing substance use (smoking, drinking, or drug use)	25.0%	15.3%	18.2%	19.9%	22.1%	38.1%	.22

^aEffect sizes estimated using linear and logistic regression R^2 and pseudo- R^2 .

^bEducation on-track for age indicates if a participant has completed the school grade expected for their age, up to high school graduation.

^cPearlin and Schooler Mastery Scale (Pearlin & Schooler, 1967)

^dHome visitor’s rating of the client’s involvement in each home visit, scale of 1–5. Averaged over all completed visits in time period.

Table 2

Multivariable associations between site characteristics and probability of class membership at the site level (n=111 sites). Each column are the results from a separate model with probability of class membership as the outcome.

	<u>Class 1</u> “consistent”	<u>Class 2</u> “inconsistent, don’t drop”	<u>Class 3</u> “drop late”	<u>Class 4</u> “gradual decline”	<u>Class 5</u> “drop early”
	standardized beta (p-value)	standardized beta (p-value)	standardized beta (p-value)	standardized beta (p-value)	standardized beta (p-value)
Black	−0.055 (<.001) ***	−0.008 (0.18)	−0.008 (0.06)	0.037 (<.001) ***	0.034 (0.002) **
Married	−0.002 (0.83)	−0.0011 (0.81)	0.005 (0.13)	0 (0.96)	−0.002 (0.80)
Sees father of baby daily	0.017 (0.12)	−0.001 (0.88)	−0.006 (0.06)	−0.009 (0.16)	−0.001 (0.89)
Percent of observations missing discharge reason	−0.032 (0.01) **	−0.008 (0.08)	0.007 (0.04) *	0.018 (0.01) **	0.016 (0.07)
Percent of site area that is rural ^a	0.01 (0.37)	−0.005 (0.33)	0.002 (0.48)	0.003 (0.63)	−0.011 (0.20)
Mean weeks pregnant when prenatal care began	0.005 (0.59)	−0.003 (0.47)	0.000388 (0.89)	0.001 (0.90)	−0.003 (0.65)
Mean mastery score ^b	−0.007 (0.41)	−0.011 (0.003) **	−0.005 (0.07)	0.004 (0.48)	0.02 (0.004) **
Mean mother’s enrollment year	−0.023 (0.08)	−0.005 (0.36)	0.002 (0.61)	0.008 (0.28)	0.018 (0.07)
Low birth weight (<2500 g, 1500 g)	0.031 (0.007) **	0.0002 (0.97)	−0.00029 (0.93)	−0.005 (0.47)	−0.026 (0.003) **
Very low birth weight (<1500 g)	0.01 (0.32)	−0.003 (0.5))	0.007 (0.03) *	−0.012 (0.03) *	−0.001 (0.85)
LBW/VLBW joint test p-value	0.002 **	0.77	0.07	0.02 *	0.004 **

* P<05;

** P<.01;

*** P<.001

^a Percentage of the service area that is rural

Pearlin and Schooler Mastery Scale (Pearlin & Schooler, 1967)
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