Prevention Science (2023) 24:1209–1224
https://doi.org/10.1007/s11121-023-01538-w

Cross-sector Collaboration Between Public Health, Healthcare and Social Services Improves Retention: Findings from a Nurse Home Visiting Program

Venice Ng Williams[1] · Beth McManus[2] · Ashley Brooks-Russell[3] · Elly Yost[4] · David Lee Olds[1] · Gregory Jackson Tung[2]

Accepted: 13 April 2023 / Published online: 20 May 2023

Abstract

The study aimed to examine the association between cross-sector collaboration in Nurse-Family Partnership (NFP), a model home visiting program, and participant retention. We used the 2018 NFP Collaboration Survey that measured agency-level collaboration, operationalized as relational coordination and structural integration, among nine community provider types (including obstetrics care, substance use treatment, child welfare). This dataset was linked to 2014–2018 NFP program implementation data ($n = 36{,}900$). We used random-intercept models with nurse-level random effects to examine the associations between provider-specific collaborations and participant retention adjusting for client, nurse, and agency characteristics. The adjusted models suggest that stronger relational coordination between nurses and substance use treatment providers (OR:1.177, 95% CI: 1.09–1.26) and greater structural integration with child welfare (OR: 1.062, CI: 1.04–1.09) were positively associated with participant retention at birth. Stronger structural integration between other home visiting programs and supplemental nutrition for women, infants, and children was negatively associated with participant retention at birth (OR: 0.985, CI: 0.97–0.99). Structural integration with child welfare remained significantly associated with participant retention at 12-month postpartum (OR: 1.032, CI: 1.01–1.05). In terms of client-level characteristics, clients who were unmarried, African-American, or visited by nurses who ceased NFP employment prior to their infant's birth were more likely to drop out of the NFP program. Older clients and high school graduates were more likely to remain in NFP. Visits by a nurse with a master's degree, agency rurality, and healthcare systems that implement the program were associated with participant retention. Cross-sector collaboration in a home visiting setting that bridges healthcare and addresses social determinants of health has potential to improve participant retention. This study sets the groundwork for future research to explore the implications of collaborative activities between preventive services and community providers.

Keywords Collaboration · Prevention · Home visiting · Retention

Introduction

High-quality home visiting services for mothers, infants, and young children can improve maternal-infant health outcomes and reduce child maltreatment (Duffee et al., 2017). Home visiting models vary in focus and content but share primary goals to develop parenting skills and support child development (Sweet & Appelbaum, 2004). However, home visiting impacts are reduced when family participation is inconsistent or ends prematurely (Raikes et al., 2006). One of the most widely adopted home visiting programs that addresses child health and development is Nurse-Family Partnership® (NFP). NFP is designed to capitalize on a sensitive period in human development by providing home visiting nurses to

✉ Venice Ng Williams
venice.williams@cuanschutz.edu

[1] Prevention Research Center for Family & Child Health, University of Colorado Anschutz Medical Campus, Aurora, USA

[2] Department of Health Systems, Management & Policy, Colorado School of Public Health, Aurora, USA

[3] Department of Community Behavioral Health, Colorado School of Public Health, Aurora, USA

[4] National Service Office for Nurse-Family Partnership and Child First, Denver, USA

pregnant first-time mothers in settings of concentrated adversity. Voluntary home visits begin early in pregnancy and continue until the child turns age 2. Home visiting nurses enhance their clients' informal social support and help link them to formal community services (Olds, 2002). Three randomized clinical trials found that NFP improved pregnancy outcomes, prevented child maltreatment, improved child development, and increased families' economic self-sufficiency (Eckenrode et al., 2010; Olds et al., 2014, 2019).

Effective coordination between prevention programs like NFP and community services and supports is essential to increasing the program's efficiency, reducing service duplication, and aligning other providers' messages (Minkovitz et al., 2016). Indeed, cross-sector collaboration — the partnering of groups from sectors like public health, healthcare, education, housing, and social services, to jointly solve problems and achieve a shared goal — is necessary to address the complex needs of families experiencing adversities (Becker & Smith, 2018). Previous research has demonstrated that public health service provision within a community requires interorganizational collaboration to be effective (Mays & Scutchfield, 2010). A growing body of literature on cross-sector collaboration suggests collaborative leadership (Corbin et al., 2016), perceptions of trust and authentic processes (Regan et al., 2016), as well as common goals and mission as major contributing factors to effective collaboration (Tung et al., 2019).

Evidence from health services and public health literature supporting the role of collaboration on health outcomes is mixed (Pomare et al., 2020; Reeves et al., 2017). For example, some studies have shown no effect (Hultberg et al., 2005, 2007; Kloek et al., 2006a, b; Lumley et al., 2006), including one that evaluated 39 community partnerships in 14 local health departments (Cheadle et al., 2008). However, some process evaluations of local health department and community partnerships have found improved service planning, capacity building, or service development (Hayes et al., 2012; Kloek et al., 2006a, b). Despite this push towards cross-sector collaboration, it is unclear how partnerships can be optimized to produce long-lasting effects (Towe et al., 2016).

One of the ways in which cross-sector collaboration may improve outcomes within the context of a home visiting prevention program like NFP is through improved care coordination, which involves deliberate organization of care activities to facilitate appropriate delivery of services (Council on Children with Disabilities & Medical Home Implementation Project Advisory Committee, 2014). Two key aspects of care coordination in the home visiting context are relational coordination and structural integration (Williams et al., 2021a). Relational coordination asserts that highly interdependent work is most effectively coordinated through relationships of shared goals, shared knowledge, and mutual respect, and supported by communication that is frequent, timely, accurate, and problem solving in nature (Gittell et al., 2020). This enables stakeholders to effectively coordinate across boundaries (Bolton et al., 2021), and has been shown in a variety of settings over the past 15 years to improve the quality and efficiency of work process in cross-sector collaborations (Gittell et al., 2020; Havens et al., 2018). An example of relational coordination is when NFP nurses communicate with healthcare providers frequently to discuss medical concerns about their shared families. Along with relational coordination processes, organizational structures that connect across professional roles predict higher levels of relational coordination, suggesting that structural integration of organizations may improve coordination (Gittell et al., 2010). Structural integration involves the sharing of resources across providers and organizations, including policies or written agreements, physical space or facilities, data or information systems, and funding or financial incentives (Williams et al., 2021a). An example of structural integration is when NFP is operated by a healthcare system: NFP nurses have access to participants' electronic medical records, work in the same physical building, and abide by the same organizational policies. Therefore, strong cross-sector collaboration through increased coordination and integrated systems may allow for more effective care coordination across systems of care and more optimal client outcomes.

In the field of program implementation, one key programmatic driver of improved client outcomes is program participation duration (i.e., participant retention). Client retention in NFP has a strong impact on the program's ability to produce positive outcomes across a variety of domains (Ingoldsby et al., 2013; O'Brien et al., 2012); ongoing research continues to examine the impacts of program duration and client retention on program outcomes. Evidence has shown that participant retention is positively influenced by the extent to which client needs are met, while home visitor turnover (especially during pregnancy) is associated with participant attrition (O'Brien et al., 2012). Studies of NFP and other home visiting prevention programs in the USA have examined a range of factors associated with client participation and attrition, including sociodemographic characteristics like age, race/ethnicity, and employment status (Alonso-Marsden et al., 2013; Duggan et al., 2000; Latimore et al., 2017; McCurdy et al., 2006; McGuigan et al., 2003; Raikes et al., 2006; Wagner et al., 2003). Women who perceive having greater emotional support (Chiang et al., 2018; Navaie-Waliser et al., 2000) and have a higher education (Raikes et al., 2006) tend to participate in these programs for longer durations or have more visits. Qualitative studies in NFP suggest that retention is influenced by client characteristics including level of readiness for change and competing demands, the quality of the nurse-client relationship, nurse flexibility and supportive care, program "fit," and "disruptive influences" such as moving away from the service area or being assigned a new nurse (Beasley et al., 2018; Holland et al., 2012; Williams et al., 2021b).

Despite the many studies examining factors that predict participant retention, few have considered the role of home visitor collaboration with other service providers. Examining the associations between participant retention and nurse collaboration with other service providers will help us better understand a feature of program implementation that predicts program success. This enables us to monitor program effectiveness in improving maternal-infant health outcomes not only for NFP, but other evidence-based prevention programs that focus on the perinatal and early childhood periods. To investigate the relationship between agency-level collaboration and client-level outcomes, we tested the hypothesis that collaboration, as measured by relational coordination and structural integration, is associated with participant retention. Figure 1 shows the conceptual model that informed this investigation.

Methods

Data Sources

The primary data for this study come from the NFP Data Warehouse available from the NFP National Service Office, a non-profit organization responsible for overseeing the implementation of NFP across the USA, and have been used in previous studies to examine program effects like low birthweight and preterm birth (Thorland & Currie, 2017) and maternal educational attainment and employment (Flowers et al., 2020). Client-, nurse-, and agency-level covariates and client-level outcomes derive from data forms gathered by nurses as part of program implementation.

The second data source was the 2018 NFP Collaboration Survey, which operationalized collaboration as two key components of relational coordination and structural integration. The NFP Collaboration Survey was implemented in October 2018 with nursing supervisors who were invited to participate in the survey as a representative for their agency. The survey assessed the degree of cross-sector collaboration (relational coordination and structural integration) with nine provider types including four healthcare (obstetric care, pediatric care, mental health, substance use treatment) and five social service providers (Child Protective Services — CPS, Special Supplemental Nutrition Program for Women and Infants — WIC, housing services, parenting programs, early intervention). The development of the survey including its measures of relational coordination and structural integration (i.e. pretesting and pilot testing) and implementation of this survey is detailed elsewhere (Williams et al., 2021a); relational coordination in the home visiting setting had a Cronbach's alpha of 0.86 or higher, where the seven dimensions behave as a single factor with an eigenvalue of 3.8 or higher. Finally, we linked the NFP Community Provider Collaboration Survey data to 2013–2018 NFP program implementation from the NFP Data Warehouse and 2013 Rural–Urban Continuum Codes (RUCC) from the US Department of Agriculture Economic Research Service.

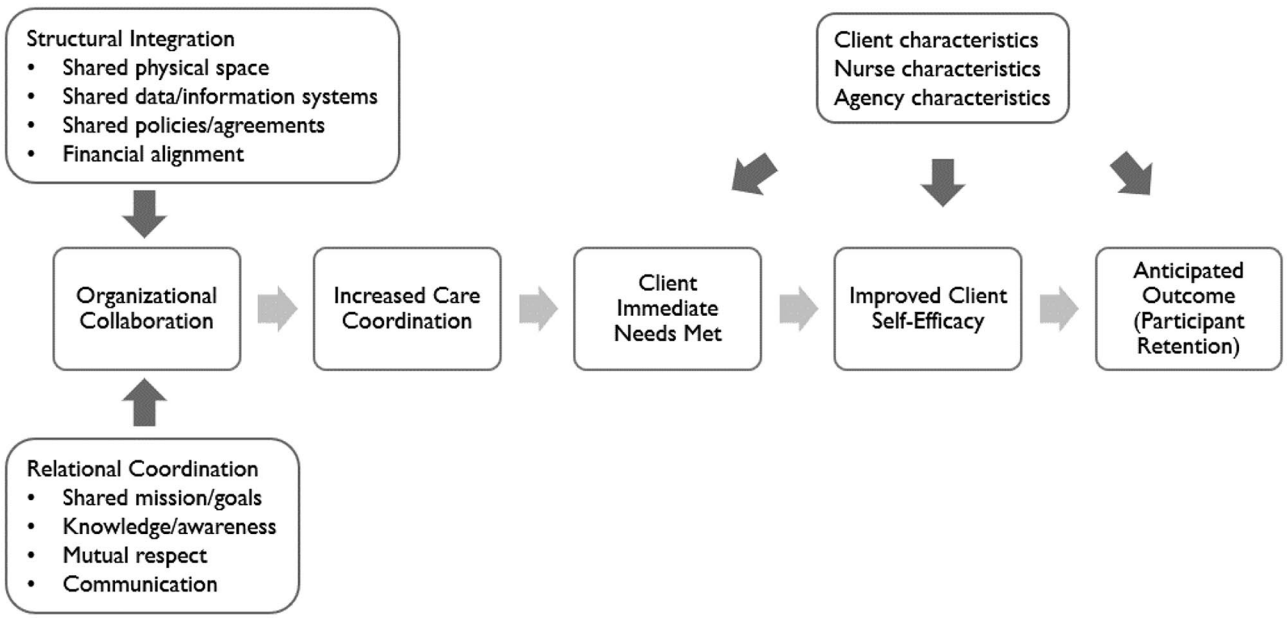

Fig. 1 Conceptual model

Sample

We included clients who enrolled in the NFP program from January 2014 through March 2019 if their agency had scores for relational coordination and structural integration for all nine provider types from the NFP Collaboration Survey ($n = 147$). Clients needed to have had at least one home visit in pregnancy between January 2, 2014, and March 26, 2019, to be included in the sample and to be assigned at least one nurse home visitor. We excluded 1039 clients due to "unaddressable attrition" (Holland et al., 2014), such as clients who ceased participation due to death, miscarriage, lost custody of the child, or infant death, resulting in a sample of 36,900 clients for retention at birth. Nurses were excluded if they had no visit data during the study period, ceased employment in the program prior to January 1, 2014, and/or did not match to any client's assigned nurse identification number. For participant retention at birth, the sample included 36,900 clients and 1516 nurses, with an average of eight completed visits in pregnancy. For participant retention at 12 months postpartum, the sample included 28,917 clients and 1295 nurses, with an average of 20 completed visits through 12-month postpartum. Note that typically NFP clients receive weekly visits in their first month of program enrollment, every other week in pregnancy until delivery, weekly during the first 6-week postpartum, then every other week to monthly until the child turns age 2. Although the NFP program is structured, nurses are encouraged to adapt visit frequency based on client needs.

Measures

Participant retention is the outcome of interest and is dichotomous for each time point and measured as whether the client was retained in the program at the child's birth, at 6-month postpartum, and 12-month postpartum. Client-level covariates were assessed at registration. These included race, ethnicity, age, education, marital status, sense of control measured by the Pearlin Self-Mastery Scale (Pearlin & Schooler, 1978), if the participant's nurse home visitor left NFP employment before the baby was born, history of physical health problems, and history of mental health problems. Nurse-level covariates were tenure in the program and highest nursing education level assessed at hiring. Agency-level covariates included agency type, years implementing NFP, rurality, and if the agency serves multiple counties. RUCC classification schemes are one through nine (most urban to most rural). We constructed agency-level rurality using mean RUCC codes if the agency serves more than one county.

The predictors of interest are collaboration measures of relational coordination and structural integration obtained from the NFP Collaboration Survey implemented with nursing supervisors (Williams et al., 2021a). We included relational coordination and structural integration scores with nine provider types (obstetric care, pediatric care, mental health, substance use, CPS, WIC, housing, parenting programs, and early intervention). Relational coordination was measured as high-quality communication (a function of frequency, timeliness, accuracy, and problem solving rather than blaming) which is reinforced by high-quality relationships based upon shared goals, shared knowledge, and mutual respect, using the validated 7-item Relational Coordination Scale (Valentine et al., 2015). This scale consisted of seven items with five response options ranging from never/nothing/not at all to constantly/completely (coded numerically from 1 to 5). The seven items are averaged for each provider type to create a relational coordination score for each provider type. To complement the measures of relational coordination, we adapted the 17-item Interagency Collaboration Activities Scale to 4-items to capture other collaborative activities of a structural nature that align with home visiting activities (Dedrick & Greenbaum, 2011). Structural integration was measured with 4-items: (1) shared policies or agreements, (2) shared funding, (3) shared facility space, and (4) shared data or information systems, with five response options ranging from not at all to very much (coded numerically from 1 to 5). The four items for each provider type are summed to create a structural integration score for each provider type.

Statistical Analysis

We examined the associations between provider-specific collaboration measures (i.e., relational coordination and structural integration) and individual-level retention using random intercept logistic regression models (a simple case of the hierarchical linear model) to account for nested data, in particular nurse-level time-invariant factors. This approach was used to account for the fact that clients served by the same nurse share a similar experience, which makes them more alike than individuals served by other nurses. We fit five models: (1) null model with no predictors or covariates to describe the overall between-nurse variability in outcomes, (2) Model 2 adjusted for the collaboration measures of interest by including the relational coordination and structural integration predictor variables, (3) Model 3 added client-level sociodemographic and health covariates, (4) Model 4 further adjusted for nurse-level covariates, and (5) Model 5 added in agency-level covariates. Hausman tests for endogeneity were conducted to assess whether fixed effects or random effects were more efficient for the models. All analyses were conducted in Stata-SE version 14. Random effect models were calculated using the Stata melogit and mixed functions from the StataCorp 14 manual.

Sensitivity Analyses

We conducted sensitivity analyses of our models including using a re-classification of agency type to specifically distinguish federally qualified health centers, including only clients with greater than four home visits, defining participant retention to include all visits (i.e. home and telehealth visits), and including client substance use (yes/no) as an additional covariate. Reclassification of agency type did not yield changes in the significance or direction of the associations between collaboration measures and participant retention. When examining participant retention at birth and at 12-month postpartum for all types of visits, the significance and direction of associations also did not change. Including clients with > 4 home visits reduced our sample size for retention at birth to 31,434 clients and produced the same significant associations with relational coordination with substance use treatment providers and integration with CPS, as well as a newly significant association with integration with obstetrics care providers. For retention at 12 months, including clients with > 4 home visits reduced our sample size for to 24,819 clients and produced only significant negative associations with integration with pediatrics. Including client substance use in the model did not yield changes in the significance or direction of associations. We also conducted sub-analyses among NFP clients experiencing multiple adversities: those without a high school degree, were unmarried, or of young age (< 20 years). We conducted sub-analyses among each of these subgroups and among those who met all three criteria. We did not find substantial differences than the results reported in the full group analyses.

Results

Of the NFP client population enrolled from January 2014 through March 2019 ($n = 119{,}769$), 36,900 women (30.8% of whole NFP population) met our inclusion criteria defined above and were included in the analyses for participant retention. Supplemental Information Attachment 1 shows the flow diagram of the sample selection. The majority of the study cohort of clients were White (47.5%), non-Hispanic (69%), high school graduates (66%), and single (77%; see Table 1). Among these 36,900 clients, we included 1516 nurses (39.7% of all nurses), who on average served 24 clients during the sample time period, in the analyses. There were significant statistical differences ($p < 0.01$) in client-, nurse-, and agency-level characteristics between agencies who responded to the survey and those that did not (see Supplemental Information Attachment 2). However, clients in this study are similar to the general NFP population. Cumulative NFP data from 1995 to 2017 show the median NFP client age as 20 compared to the median age of 21 in this study (Nurse-Family Partnership, 2019). Fifty-one percent of NFP clients are White compared to 48% White mothers in this study, while 29% of NFP clients are Hispanic compared to 31% in this study. Eighty-four percent of NFP mothers are unmarried, and 57% have completed high school, compared to 84% unmarried and 66% having completed high school in this study.

Mean relational coordination and structural integration scores are presented in Table 2. A higher relational coordination mean indicates greater communication coupled with stronger relationships. Among all providers, the mean relational coordination was 3.21, which represents occasional to some coordination. The highest reported coordination was with WIC (mean score = 3.77), followed by early intervention (mean score = 3.44) and obstetric care (mean score = 3.39) providers (Table 2). With structural integration, a higher mean indicates greater sharing of space, policies, data, and funding. The greatest structural integration with NFP occurred with WIC (mean score = 8.03), followed by mental health (mean score = 7.06) and obstetric care (mean score = 6.60).

Principal Results

The results of the random intercepts models are presented in Tables 3 and 4. The results of Model 1 suggest nurse variation in the probability of participant retention at birth ($\sigma_u^2 = 0.29$; SE = 0.02) and at 12-month postpartum ($\sigma_u^2 = 0.36$; SE = 0.03). In Model 2, we included collaboration measures, operationalized as relational coordination and structural integration, with eight provider types. Relational coordination between obstetric and pediatric care were highly correlated ($r = 0.65$), as was structural integration between the two provider types ($r = 0.74$). Since we hypothesized that collaborating with obstetrics would have a greater influence on retention at birth than that with pediatric care, we omitted the pediatric care collaboration variables. Compared to the null model, adding in the predictors (Model 2) and covariates at the client- (Model 3) and agency-level (Model 5) explained incrementally greater proportions of between-nurse variability in participant retention (14%, 22%, and 30% respectively). Model 4 (adding nurse-level covariates) did not explain additional between-nurse variability (20%). The full model (Model 5) suggests that the adjusted odds of participant retention at birth is 18 percentage points higher for each unit increase in nurse-reported relational coordination with substance use treatment providers and 6 percentage points higher for each unit increase in structural integration with CPS. Structural integration with WIC had a small negative relationship with retention at birth (1.5 percentage points lower for each unit increase in structural integration).

Table 1 Characteristics of sample — client, nurse, and agency characteristics

Sample characteristics ($n = 36{,}900$)	*Frequency*	%	*M*	*SD*
Client age (years)	-	-	22.50	5.18
Client race:				
White	17,532	47.51	-	-
African-American	12,154	32.94	-	-
Other race	4,164	11.28	-	-
Race declined	3,050	8.27	-	-
Client Hispanic (yes)	11,445	31.02	-	-
Client finished high school (yes)	24,513	66.43	-	-
Client marital status:				
Married	5,936	16.09	-	-
Single	28,471	77.16	-	-
Not married, live-in partner	1,638	4.44	-	-
Widowed/divorced/separated	855	2.32	-	-
Client Mastery (Pearlin)	-	-	18.72	2.68
Client history of blood pressure (yes)	1,347	3.65	-	-
Client history of diabetes (yes)	966	2.62	-	-
Client history of mental illness (yes)	935	2.53	-	-
Nurse left program before child's birth (yes)	2,200	5.96	-	-
Nurse tenure (years)	-	-	5.65	4.10
Nurse highest education level:				
Associate/Diploma	4,492	12.17	-	-
Bachelor	28,809	78.07	-	-
Master or higher	3,599	9.75	-	-
Agency type:				
Public health agency	17,268	46.80	-	-
Community-based organization	11,823	32.04	-	-
Healthcare	5,956	16.14	-	-
Other type	1,853	5.02	-	-
Agency tenure:				
≤ 5 years	1,963	5.32	-	-
6–10 years	16,880	45.75	-	-
11–15 years	7,171	19.43	-	-
16–20 years	8,492	23.01	-	-
20 + years	2,394	6.49	-	-
Agency rurality	-	-	2.45	1.75
Agency serves multiple counties (yes)	16,647	45.11	-	-

For participant retention at 12-month postpartum, collaboration measures with eight provider types were included in Model 2, excluding the obstetric care collaboration variables. Contrary to participant retention at birth, we hypothesized that collaborating with pediatric care would have a greater influence on participant retention at 12-month postpartum than that with obstetric care. Again compared to the null model, adding in predictors (Model 2) and covariates at the client- (Model 3), nurse- (Model 4), and agency-level (Model 5) explained incrementally greater proportions of between-nurse variability in participant retention (10%, 11%, 13%, and 17% respectively). The full model (Model 5) suggests that the adjusted odds of participant retention at 12 months is 3 percentage points higher for each unit increase in structural integration with CPS. Structural integration with pediatrics had a small negative relationship with retention at 12 months (2.8 percentage points lower for each unit increase in structural integration).

Table 2 Distribution of collaboration measures

Collaboration measures	*n*	*M*	*SD*
Relational coordination index score across all providers	236	3.21	0.62
Relational coordination dimensions across all providers			
Shared goals	227	3.55	0.85
Mutual respect	226	3.54	0.76
Accurate communication	230	3.40	0.96
Shared knowledge	229	3.20	0.66
Problem solving communication	229	3.13	0.79
Timely communication	231	3.06	0.77
Frequent communication	238	2.87	0.65
Relational Coordination scores by provider type			
WIC	235	3.77	0.90
Early intervention	233	3.44	0.90
Obstetrics care providers	236	3.39	0.79
Child welfare	234	3.28	0.73
Mental health providers	232	3.24	0.83
Parenting programs	222	3.23	0.95
Pediatric care providers	234	3.13	0.82
Substance use treatment providers	219	2.74	0.89
Housing resources	225	2.55	0.93
Structural Integration index score across providers	225	6.07	1.61
Shared Resources dimensions across all providers			
Shared physical space	225	1.68	0.59
Shared policies	225	1.65	0.77
Shared data	225	1.44	0.55
Shared funding	225	1.31	0.41
Structural Integration scores by provider type			
WIC	218	8.03	4.17
Mental health providers	223	7.06	3.86
Obstetrics care providers	225	6.60	3.56
Parenting programs	218	6.50	3.65
Pediatric care providers	224	5.92	3.31
Early intervention	219	5.70	3.25
Child welfare (CPS)	217	5.28	2.44
Substance use treatment providers	222	5.07	2.42
Housing resources	218	4.44	1.39

Discussion

We examined the relationships between nurse collaboration with providers and participant retention, a key driver of program effectiveness to improve maternal-infant health outcomes, within the context of the NFP program. We found small but significant associations between provider-specific collaboration and participant retention, which add to the current research on relational coordination and improvements of patient-reported outcomes and nurse-rated quality of care (Bolton et al., 2021). Specifically, stronger relational coordination between nurses and substance use treatment providers and greater structural integration with child welfare were positively associated with participant retention at birth. Stronger structural integration between the home visiting program and supplemental nutrition for women, infants, and children was negatively associated with participant retention at birth. Structural integration with child welfare remained significantly associated with participant retention at 12-month postpartum.

This study is the first to examine the role of relational coordination and structural integration with other service providers on participant retention in a national evidence-based home visiting program. The first major finding of our research is that nurse-reported relational coordination with substance use treatment providers was strongly associated with retaining participants at birth, but not at 12-month postpartum, above and beyond adjusting for client-, nurse-, and agency-level factors. This finding suggests that relational coordination with substance use treatment providers may be particularly important to retain participants who use substances and are engaged in treatment. Previous literature suggests that case management services including home visits contribute to retention of pregnant women in substance use treatment (Laken & Ager, 1996), as does colocation of midwifery services at addiction treatment programs (Goodman, 2015). For pregnant and postpartum women with substance use disorder, the coordination of substance use treatment, wraparound services like nutrition and mental health services, and trauma-informed family-centered care like NFP is needed to address their needs.

The second major finding of our research is that greater structural integration with CPS was associated with better participant retention at birth and 12-month postpartum, adjusting for client-, nurse-, and agency-level factors. Prior research suggests that some child welfare agencies have data sharing and contractual relationships with other child serving organizations (Bunger et al., 2014) and that partnerships can be promoted between child welfare and child health services through greater information sharing (Prince & Austin, 2005). In the case of NFP, integration with CPS may include colocation (i.e., NFP is operated by a local Department of Human Services), having a Memorandum of Understanding in place to allow release of information, or being partially funded by the Child Abuse Prevention and Treatment Act (2018). This is the first study to find that when nurse home visiting programs share resources in the form of physical space, policies, data, and funding with child welfare, we may see improvements in the retention of participants.

We also found that structural integration with WIC had a small negative association with participant retention at birth that was not statistically significant at 12-month postpartum. As most NFP sites that are well integrated with WIC tend to operate out of public health agencies, some participants, particularly

Table 3 All random effects models for participant retention at birth

Outcome: Retention at birth	*Null*	*Model 2 Odds ratios (SE)*	*Model 3 Odds ratios (SE)*	*Model 4 Odds ratios (SE)*	*Model 5 Odds ratios (SE)*
Agency-level predictors					
Relational coordination with obstetrics care		1.040	1.062	1.062	1.016
		(−0.04)	(−0.04)	(−0.04)	(−0.04)
Relational coordination with WIC		0.990	0.961	0.963	0.955
		(−0.03)	(−0.03)	(−0.03)	(−0.03)
Relational coordination with early intervention		1.038	1.019	1.019	1.012
		(−0.04)	(−0.03)	(−0.04)	(−0.03)
Relational coordination with mental health		0.905*	0.911*	0.911*	0.942
		(−0.04)	(−0.04)	(−0.04)	(−0.04)
Relational coordination with substance use treatment		1.173***	1.174***	1.173***	1.177***
		(−0.04)	(−0.04)	(−0.04)	(−0.04)
Relational coordination with CPS		1.071	1.04	1.039	0.998
		(−0.04)	(−0.04)	(−0.04)	(−0.04)
Relational coordination with housing resources		0.982	0.994	0.997	0.995
		(−0.03)	(−0.03)	(−0.03)	(−0.03)
Relational coordination with parenting programs		1.037	1.049	1.048	1.037
		(−0.03)	(−0.03)	(−0.03)	(−0.03)
Structural integration with obstetrics care		1.017*	1.016*	1.016*	1.012
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural integration with WIC		0.978***	0.978***	0.978***	0.985*
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural integration with early intervention		0.994	0.998	0.998	0.994
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural integration with mental health		0.994	0.993	0.993	0.993
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural integration with substance use treatment		1.001	0.995	0.994	0.995
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural integration with CPS		1.057***	1.057***	1.057***	1.062***
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural integration with housing resources		0.99	0.985	0.984	1.007
		(−0.02)	(−0.02)	(−0.02)	(−0.02)
Structural integration with parenting programs		0.997	0.995	0.995	0.994
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Client-level co-variates					
Client age (years)			1.034***	1.034***	1.035***
			(−0.00)	(−0.00)	(−0.00)
Client race:					
White			Reference	Reference	Reference
African-American			0.904**	0.905**	0.929*
			(−0.03)	(−0.03)	(−0.03)
Other race			0.979	0.979	0.989
			(−0.05)	(−0.05)	(−0.05)
Race declined			1.035	1.035	1.057
			(−0.06)	(−0.06)	(−0.06)
Client ethnicity: Hispanic			0.998	0.997	1.020
			(−0.04)	(−0.04)	(−0.04)
Client finished high school			1.171***	1.171***	1.170***
			(−0.04)	(−0.04)	(−0.04)

Table 3 (continued)

Outcome: Retention at birth	*Null*	*Model 2 Odds ratios (SE)*	*Model 3 Odds ratios (SE)*	*Model 4 Odds ratios (SE)*	*Model 5 Odds ratios (SE)*
Client marital status:					
Married			Reference	Reference	Reference
Single			0.743***	0.743***	0.742***
			(−0.03)	(−0.03)	(−0.03)
Not married, live-in partner			0.748***	0.750***	0.748***
			(−0.06)	(−0.06)	(−0.06)
Widowed/divorced/separated			0.658***	0.658***	0.657***
			(−0.07)	(−0.07)	(−0.07)
Client mastery (Pearlin)			0.985**	0.985**	0.985**
			(−0.00)	(−0.01)	(−0.00)
Client history of high blood pressure			0.899	0.899	0.889
			(−0.07)	(−0.07)	(−0.07)
Client history of diabetes			1.016	1.016	1.011
			(−0.09)	(−0.09)	(−0.09)
Client history of mental health			1.294**	1.292**	1.279*
			(−0.13)	(−0.13)	(−0.13)
Nurse left program before child's birth			0.414***	0.415***	0.415***
			(−0.03)	(−0.03)	(−0.03)
Nurse-level co-variates					
Nurse tenure (years)				1.002	0.998
				(−0.01)	(−0.01)
Nurse highest education level:					
Associate/Diploma				Reference	Reference
Bachelor				1.022	1.132
				(−0.07)	(−0.08)
Master or higher				1.111	1.213*
				(−0.10)	(−0.11)
Agency-level co-variates					
Agency tenure:					
≤ 5 years					Reference
> 5 to < 11 years					1.057
					(−0.11)
11 to 15 years					1.147
					(−0.12)
> 15 to < 20 years					1.331**
					(−0.14)
20 + years					1.127
					(−0.13)
Agency rurality					1.073***
					(−0.02)
Agency serves multiple counties					0.813***
					(−0.04)
Agency type:					
Public health agency					Reference
Community-based organization					1.219***
					(−0.07)
Healthcare					1.356***
					(−0.11)

Table 3 (continued)

Outcome: Retention at birth	*Null*	*Model 2 Odds ratios (SE)*	*Model 3 Odds ratios (SE)*	*Model 4 Odds ratios (SE)*	*Model 5 Odds ratios (SE)*
Other type					1.451***
					(−0.16)
Observations	36,900	36,900	36,900	36,900	36,900
Nurse variation (SE)	0.295 (0.024)	0.252 (0.022)	0.231 (0.020)	0.231 (0.020)	0.206 (0.019)
Explained variance, %[a]	15	22	20	30	
Intra-class correlation (nurse)	0.0823	0.071	0.066	0.066	0.059

*$p<0.05$, **$p<0.01$, ***$p<0.01$

[a]To determine the relative contribution of each model to the between-nurse variance in participant retention, we used the formula: $(V_0 - V_1)/V_0$, where V_0 is the nurse-level variance in the null model and V_1 is the nurse-level variance of the adjusted model

those with previous adverse experiences with government services, may hold negative perceptions of health agencies and public services potentially leading to greater odds of attrition. At 12-month postpartum, structural integration with pediatrics was negatively associated with participant retention. This finding is also puzzling, and future research is needed to understand why there are unexpected negative associations between structural integration and participant retention. It is possible that each factor of integration (shared space, policies, data, and funding) may disproportionately affect participant retention and there may be unmeasured moderating variables. Previous literature on real integrated care where organizations merge their services and pooled budgets or payment mechanisms suggest that organization integration benefits are realized when integration also occurs clinically and in terms of service delivery (Ham & Curry, 2011); structural integration facilitates care coordination but in itself may not be enough to produce true health benefits. Understanding the relationship between structural integration and outcomes is complex, and we are cautious about over-emphasizing the significance of these early findings.

Significant results were found for participant retention at all time points but we reported findings on retention at child's birth and at 12-month postpartum. Our results on participant retention align with existing research on this program showing younger, unmarried, or African-American mothers more likely to drop out, while Hispanic mothers were more likely to remain in the program at 12-month postpartum (O'Brien et al., 2012). We also found that mothers with a history of mental health challenge and those who had graduated from high school or had obtained a GED at registration were more likely to remain in the program at their child's birth and at 12-month postpartum. Those with a higher sense of control in their lives (self-mastery) were less likely to be retained at birth, but there were no association with retention at 12-months postpartum. These results suggest that mothers who have a high perceived self-efficacy at enrollment may cease participation early because they do not perceive the program to be beneficial, contrary to another study that found that those with more "risks" or "chaos in their lives" are unable to fully engage in the program (Hernández et al., 2019).

In terms of nurse-level characteristics that predict participant retention, we found that those visited by nurses who left the program prior to the client's child's birth were more likely to drop out, while participants visited by nurses with a master's degree were more likely to remain in the program. Nurse tenure had no effect on participant retention. These results suggest that nurse expertise and the relationship established with the family in pregnancy matters, the latter aligning with previous research (O'Brien et al., 2012).

This study also identified salient agency-level predictors of participant retention that require further investigation. This study is the first to identify agency type as a significant predictor of participant retention; notably, healthcare systems tend to retain participants better than public health agencies. We hypothesized agency type to influence the degree of collaboration (predictors) as well as participant retention (outcome), and included this variable as a co-variate in our model. Our early analyses suggest that agency type may reflect other influences on program implementation or elements of collaboration not measured by our predictors: relational coordination and structural integration. Future work will further explore this relationship.

Limitations

The major limitations to this study lay in the observational nature of the analysis, largely due to agency-level collaboration predictors that were measured at only one point in time, after the majority of participants were enrolled in the program. We do not know whether collaboration improved or worsened over the study time period, but we included clients who were enrolled during those times. However, we believe that collaboration is relatively stable over time and given that there were no systematic or uniform national efforts by

Table 4 All random effects models for participant retention at 12-month postpartum

Outcome: Retention at 12 months	*Null*	*Model 2* *Odds ratios (SE)*	*Model 3* *Odds ratios (SE)*	*Model 4* *Odds ratios (SE)*	*Model 5* *Odds ratios (SE)*
Agency-level predictors					
Relational Coordination with pediatric care		1.033	1.036	1.042	1.046
		(−0.04)	(−0.04)	(−0.04)	(−0.04)
Relational Coordination with WIC		1.061	1.032	1.022	1.010
		(−0.03)	(−0.03)	(−0.03)	(−0.03)
Relational Coordination with early intervention		1.057	1.039	1.037	0.999
		(−0.04)	(−0.04)	(−0.04)	(−0.04)
Relational Coordination with mental health		0.879**	0.900*	0.903*	0.938
		(−0.04)	(−0.04)	(−0.04)	(−0.04)
Relational Coordination with substance use treatment		1.090*	1.079*	1.086*	1.041
		(−0.04)	(−0.04)	(−0.04)	(−0.04)
Relational Coordination with CPS		1.118*	1.083	1.069	1.041
		(−0.05)	(−0.05)	(−0.05)	(−0.05)
Relational Coordination with housing resources		1.002	1.008	1.008	1.045
		(−0.03)	(−0.03)	(−0.03)	(−0.04)
Relational Coordination with parenting programs		1.028	1.065	1.064	1.064
		(−0.03)	(−0.04)	(−0.04)	(−0.04)
Structural Integration with pediatric care		0.986	0.991	0.992	0.972**
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural Integration with WIC		0.977***	0.977***	0.978***	0.991
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural Integration with early intervention		0.992	1.002	1.000	0.989
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural Integration with mental health		1.014	1.012	1.011	1.010
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural Integration with substance use treatment		0.995	0.988	0.987	0.997
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural Integration with CPS		1.032**	1.028*	1.026*	1.032**
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Structural Integration with housing resources		1.023	1.029	1.027	1.042
		(−0.03)	(−0.03)	(−0.03)	(−0.03)
Structural Integration with parenting programs		1.004	0.999	1.002	1.004
		(−0.01)	(−0.01)	(−0.01)	(−0.01)
Client-level co-variates					
Client age (years)			1.048***	1.048***	1.048***
			(−0.00)	(−0.00)	(−0.00)
Client race:					
White			Reference	Reference	Reference
African-American			0.804***	0.807***	0.818***
			(−0.03)	(−0.03)	(−0.03)
Other race			0.968	0.969	0.979
			(−0.04)	(−0.04)	(−0.04)
Race declined			0.980	0.987	1.006
			(−0.0532	(−0.05)	(−0.06)
Client ethnicity: Hispanic			1.108**	1.108**	1.118**
			(−0.04)	(−0.04)	(−0.04)
Client finished high school			1.326***	1.325***	1.323***
			(−0.04)	(−0.04)	(−0.04)
Client marital status:					

Table 4 (continued)

Outcome: Retention at 12 months	*Null*	*Model 2* *Odds ratios (SE)*	*Model 3* *Odds ratios (SE)*	*Model 4* *Odds ratios (SE)*	*Model 5* *Odds ratios (SE)*
Married			Reference	Reference	Reference
Single			0.755***	0.755***	0.753***
			(−0.03)	(−0.03)	(−0.03)
Not married, live-in partner			0.722***	0.730***	0.726***
			(−0.07)	(−0.07)	(−0.07)
Widowed/divorced/separated			0.675***	0.675***	0.675***
			(−0.06)	(−0.07)	(−0.06)
Client mastery (Pearlin)			0.991	0.992	0.991
			(−0.01)	(−0.00)	(−0.00)
Client history of high blood pressure			1.077	1.079	1.072
			(−0.07)	(−0.07)	(−0.07)
Client history of diabetes			0.939	0.941	0.937
			(−0.08)	(−0.08)	(−0.08)
Client history of mental health			1.182*	1.177*	1.171*
			(−0.09)	(−0.09)	(−0.09)
Nurse left program before child's birth			0.778***	0.801**	0.809**
			(−0.05)	(−0.06)	(−0.06)
Nurse-level co-variates					
Nurse tenure (years)				1.020***	1.023***
				(−0.01)	(−0.01)
Nurse highest education level:					
Associate/Diploma				Reference	Reference
Bachelor's Degree				1.020	1.070
				(−0.07)	(−0.08)
Master's Degree or higher				0.994	1.037
				(−0.09)	(−0.10)
Agency-level co-variates					
Agency tenure:					
≤ 5 years					Reference
> 5 to < 11 years					0.907
					(−0.10)
11 to 15 years					0.897
					(−0.11)
> 15 to < 20 years					0.910
					(−0.11)
20 + years					0.992
					(−0.14)
Agency rurality					1.018
					(−0.02)
Agency serves multiple counties					0.883*
					(−0.05)
Agency type:					
Public health agency					Reference
Community-Based Organization					1.115
					(−0.07)
Healthcare					1.587***
					(−0.14)
Other type					1.472***
					(−0.17)

Table 4 (continued)

Outcome: Retention at 12 months	*Null*	*Model 2* *Odds ratios (SE)*	*Model 3* *Odds ratios (SE)*	*Model 4* *Odds ratios (SE)*	*Model 5* *Odds ratios (SE)*
Observations	28,917	28,917	28,917	28,917	28,917
Nurse variation (SE)	0.365 (0.029)	0.328 (0.027)	0.323 (0.028)	0.319 (0.027)	0.304 (0.027)
Explained variance, %[a]	10	12	13	17	
Intra-class correlation (nurse)	0.100	0.09	0.090	0.088	0.084

$^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.01$

[a]To determine the relative contribution of each model to the between-nurse variance in participant retention, we used the formula: $(V_0-V_1)/V_0$, where V_0 is the nurse-level variance in the null model and V_1 is the nurse-level variance of the adjusted model

the NFP program to improve provider collaboration over the study period.

Most regression coefficients are relatively small. Future research should consider examining the effect of provider-specific collaboration on other program outcomes including maternal health and service utilization. Additional research should focus on better understanding the influence of agency type and other moderating variables that affect the associations between the collaboration measures of interest in this study and participant retention.

Finally, we note that this analysis included 144 NFP agencies, while there were 241 agencies represented in the NFP Data Warehouse during this timeframe. This is due to our inclusion of agencies that had scores for relational coordination and structural integration with all provider types, which limits our ability to provide conclusions on the relationship between cross-sector collaboration and participant retention for all NFP agencies. We further acknowledge that time-to-event or social network analysis methodologies may offer additional insight into the dynamics of participant retention, and future research should explore these opportunities.

Conclusions

Policy-makers have called for increased care coordination among providers across sectors, roles, and disciplines, as a way to achieve higher quality and more cost-effective care. This study provides early results that suggest cross-sector collaboration in a nurse home visiting setting, that bridges healthcare and addresses social determinants of health, and that has potential to improve participant retention which is necessary to maximize program impact. Evidence-based prevention programs have the ability to improve the experience of high-need families at risk for adverse effects of poverty. Integrating with providers and health systems, and more importantly developing strong relationships based on shared goals, knowledge, and mutual respect will facilitate coordinated care and communication of family needs. Our findings suggest that collaboration with specific provider types, above and beyond characteristics among clients, home visitors, and agencies, may contribute to participant retention. These findings further set the groundwork to explore the implications of collaborative activities between preventive services and community providers to address the needs of families experiencing adversities, including whether collaboration with specific provider types improves service use and outcomes for families experiencing challenges the provider type aims to address.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11121-023-01538-w.

Acknowledgements Thanks are due to the nurse home visitors who work tirelessly to implement the program and their community partners, as well as the Nurse-Family Partnership National Service Office for supporting this research.

Funding This study was partially supported by funds from the Nurse-Family Partnership® (NFP) National Service Office through the Blue Meridian Partners.

Data Availability The data that support the findings of this study are available upon reasonable request from the corresponding author, (VW). The data are not publicly available due to their containing information that could compromise the privacy of research participants.

Declarations

Disclaimer The funders had no role in the design of the study; collection, analysis, and interpretation of data; writing the manuscript; or the decision to submit the manuscript for publication.

Ethics Approval This study was approved by the Colorado Multiple Institutional Review Board as not human subject research under protocol no. 18–0575. The study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Consent to Participate Not applicable.

Conflict of Interest DLO is the founder of NFP and, with the University of Colorado, owns the NFP intellectual property. The University

of Colorado receives royalties from governments and organizations outside of the USA that implement NFP and has contracts with those entities to guide the implementation of NFP with quality. DLO could receive personal royalties and fees, but none of the royalties or fees go to DLO personally; they are used to support the Prevention Research Center for Family and Child Health research and NFP implementation guidance. EY is an employee of the NFP National Service Office. All other authors declare no competing or financial interests.

References

Alonso-Marsden, S., Dodge, K. A., O'Donnell, K. J., Murphy, R. A., Sato, J. M., & Christopoulos, C. (2013). Family risk as a predictor of initial engagement and follow-through in a universal nurse home visiting program to prevent child maltreatment. *Child abuse & neglect*, *37*(8), 555–565. https://doi.org/10.1016/j.chiabu.2013.03.012

Beasley, L. O., Ridings, L. E., Smith, T. J., Shields, J. D., Silovsky, J. F., Beasley, W., & Bard, D. (2018). A qualitative evaluation of engagement and attrition in a nurse home visiting program: From the participant and provider perspective. *Prevention Science, 19*(4), 528–537. https://doi.org/10.1007/s11121-017-0846-5

Becker, J., & Smith, D. B. (2018). The need for cross-sector collaboration. Stanford *Social Innovation Review, 16*(1), C2–C3. https://doi.org/10.48558/8473-JD42

Bolton, R., Logan, C., & Gittell, J. H. (2021). Revisiting relational coordination: A systematic review. *The Journal of Applied Behavioral Science*, *0*(0), 0021886321991597. https://doi.org/10.1177/0021886321991597

Bunger, A. C., Collins-Camargo, C., McBeath, B., Chuang, E., Pérez-Jolles, M., & Wells, W. (2014). Collaboration competition and co-opetition: Interorganizational dynamics between private child welfare agencies and child serving sectors. *Children and Youth Services Review, 38*, 113–122. https://doi.org/10.1016/j.childyouth.2014.01.017

Child Abuse and Prevention Treatment Act, 42 U.S.C. § 5101. (2018). Retrieved September 9, from https://www.acf.hhs.gov/sites/default/files/documents/cb/capta.pdf

Cheadle, A., Hsu, C., Schwartz, P. M., Pearson, D., Greenwald, H. P., Beery, W. L., Flores, G., & Casey, M. C. (2008). Involving local health departments in community health partnerships: Evaluation results from the partnership for the public's health initiative. *Journal of Urban Health, 85*(2), 162–177. https://doi.org/10.1007/s11524-008-9260-4

Chiang, C.-J., Jonson-Reid, M., Kim, H., Drake, B., Pons, L., Kohl, P., Constantino, J., & Auslander, W. (2018). Service engagement and retention: Lessons from the early childhood connections program. *Children and Youth Services Review, 88*, 114–127. https://doi.org/10.1016/j.childyouth.2018.02.028

Corbin, J. H., Jones, J., & Barry, M. M. (2016). What makes intersectoral partnerships for health promotion work? A review of the international literature. *Health Promotion International*, daw061-daw061. https://doi.org/10.1093/heapro/daw061

Council on Children with Disabilities and medical Home Implementation Project Advisory Committee. (2014). Patient- and family-centered care coordination: A framework for integrating care for children and youth across multiple systems. *Pediatrics, 133*(5), e1451–e1460. https://doi.org/10.1542/peds.2014-0318

Dedrick, R. F., & Greenbaum, P. E. (2011). Multilevel confirmatory factor analysis of a scale measuring interagency collaboration of children's mental health agencies. *Journal of Emotional & Behavioral Disorders*, *19*(1), 27–40. https://doi.org/10.1177/1063426610365879

Duffee, J. H., Mendelsohn, A. L., Kuo, A. A., Legano, L. A., & Earls, M. F. (2017). Early childhood home visiting. *Pediatrics*, *140*(3). https://doi.org/10.1542/peds.2017-2150

Duggan, A., Windham, A., McFarlane, E., Fuddy, L., Mph, L., Rohde, C., Buchbinder, S., & Sia, C. (2000). Hawaii's healthy start program of home visiting for at-risk families: Evaluation of family identification, family engagement, and service delivery. *Pediatrics*, *105*(Supplement 2), 250. Retrieved September 9, from http://pediatrics.aappublications.org/content/105/Supplement_2/250.abstract

Eckenrode, J., Campa, M., Luckey, D. W., Henderson, C. R., Jr., Cole, R., Kitzman, H., Anson, E., Sidora-Arcoleo, K., Powers, J., & Olds, D. (2010). Long-term effects of prenatal and infancy nurse home visitation on the life course of youths: 19-year follow-up of a randomized trial. *Archives of Pediatrics and Adolescent Medicine, 164*(1), 9–15. https://doi.org/10.1001/archpediatrics.2009.240

Flowers, M., Sainer, S., Stoneburner, A., & Thorland, W. (2020). Education and employment outcomes in clients of the Nurse-Family Partnership. *Public Health Nursing, 37*(2), 206–214.

Gittell, J. H., Logan, C., Cronenwett, J., Foster, T. C., Freeman, R., Godfrey, M., & Vidal, D. C. (2020). Impact of relational coordination on staff and patient outcomes in outpatient surgical clinics. *Health Care Management Review, 45*(1), 12–20. https://doi.org/10.1097/hmr.0000000000000192

Gittell, J. H., Seidner, R., & Wimbush, J. (2010). A relational model of how high-performance work systems work. *Organization Science*, *21*(2), 490–506. https://doi.org/10.1287/orsc.1090.0446

Goodman, D. (2015). Improving access to maternity care for women with opioid use disorders: Colocation of midwifery services at an addiction treatment program. *Journal of Midwifery & Women's Health, 60*(6), 706–712.

Ham, C., & Curry, N. (2011). Integrated care: What is it? Does it work? What does it mean for the NHS? *The King's Fund.* Retrieved September 9, from https://www.kingsfund.org.uk/sites/default/files/field/field_publication_file/integrated-care-summary-chris-ham-sep11.pdf

Havens, D. S., Gittell, J. H., & Vasey, J. (2018). Impact of relational coordination on nurse job satisfaction, work engagement and burnout: Achieving the quadruple aim. *JONA: The Journal of Nursing Administration*, *48*(3), 132–140. https://doi.org/10.1097/nna.0000000000000587

Hayes, S. L., Mann, M. K., Morgan, F. M., Kelly, M. J., & Weightman, A. L. (2012). Collaboration between local health and local government agencies for health improvement. *Cochrane Database of Systematic Reviews*, *10*, Cd007825. https://doi.org/10.1002/14651858.CD007825.pub6

Hernández, D., Topping, A., Hutchinson, C. L., Martin, A., Brooks-Gunn, J., & Petitclerc, A. (2019). Client attrition in the Nurse-Family Partnership®: Revisiting metrics of impact in a home visitation program in the United States. *Health and Social Care in the Community, 27*(4), e483–e493. https://doi.org/10.1111/hsc.12748

Holland, M. L., Christensen, J. J., Shone, L. P., Kearney, M. H., & Kitzman, H. J. (2014). Women's reasons for attrition from a nurse home visiting program. *Journal of Obstetric, Gynecologic, and Neonatal Nursing, 43*(1), 61–70. https://doi.org/10.1111/1552-6909.12263

Holland, M. L., Yoo, B. K., Kitzman, H., Chaudron, L., Szilagyi, P. G., & Temkin-Greener, H. (2012). Mother-child interactions and the associations with child healthcare utilization in low-income urban families. *Maternal and Child Health Journal, 16*(1), 83–91. https://doi.org/10.1007/s10995-010-0719-z

Hultberg, E.-L., Lönnroth, K., & Allebeck, P. (2005). Interdisciplinary collaboration between primary care, social insurance and

social services in the rehabilitation of people with musculoskeletal disorder: Effects on self-rated health and physical performance. *Journal of Interprofessional Care, 19*(2), 115–124.

Hultberg, E.-L., Lönnroth, K., & Allebeck, P. (2007). Effects of a co-financed interdisciplinary collaboration model in primary health care on service utilisation among patients with musculoskeletal disorders. *Work, 28*(3), 239–247.

Ingoldsby, E. M., Baca, P., McClatchey, M. W., Luckey, D. W., Ramsey, M. O., Loch, J. M., Lewis, J., Blackaby, T. S., Petrini, M. B., Smith, B. J., McHale, M., Perhacs, M., & Olds, D. L. (2013). Quasi-experimental pilot study of intervention to increase participant retention and completed home visits in the Nurse-Family Partnership. *Prevention Science, 14*, 525–534. https://doi.org/10.1007/s11121-013-0410-x

Kloek, G. C., Van Lenthe, F. J., Meertens, Y. M., Koelen, M. A., & Mackenbach, J. P. (2006a). Process evaluation of a Dutch community intervention to improve health related behaviour in deprived neighbourhoods. *Sozial-Und Präventivmedizin/social and Preventive Medicine, 51*(5), 259.

Kloek, G. C., van Lenthe, F. J., van Nierop, P. W., Koelen, M. A., & Mackenbach, J. P. (2006b). Impact evaluation of a Dutch community intervention to improve health-related behaviour in deprived neighbourhoods. *Health & Place, 12*(4), 665–677.

Laken, M. P., & Ager, J. W. (1996). Effects of case management on retention in prenatal substance abuse treatment. *The American Journal of Drug and Alcohol Abuse, 22*(3), 439–448.

Latimore, A. D., Burrell, L., Crowne, S., Ojo, K., Cluxton-Keller, F., Gustin, S., Kruse, L., Hellman, D., Scott, L., Riordan, A., & Duggan, A. (2017). Exploring multilevel factors for family engagement in home visiting across two national models. *Prevention Science, 18*(5), 577–589. https://doi.org/10.1007/s11121-017-0767-3

Lumley, J., Watson, L., Small, R., Brown, S., Mitchell, C., & Gunn, J. (2006). PRISM (Program of Resources, Information and Support for Mothers): A community-randomised trial to reduce depression and improve women's physical health six months after birth [ISRCTN03464021]. *BMC Public Health, 6*(1), 37.

Mays, G. P., & Scutchfield, F. D. (2010). Improving public health system performance through multiorganizational partnerships. *Preventing Chronic Disease*, *7*(6), A116. Retrieved September 9 from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2995603/

McCurdy, K., Daro, D., Anisfeld, E., Katzev, A., Keim, A., LeCroy, C., McAfee, C., Nelson, C., Falconnier, L., McGuigan, W. M., Park, J. K., Sandy, J., & Winje, C. (2006). Understanding maternal intentions to engage in home visiting programs. *Children and Youth Services Review*, *28*(10), 1195–1212. https://doi.org/10.1016/j.childyouth.2005.11.010

McGuigan, W. M., Katzev, A. R., & Pratt, C. C. (2003). Multi-level determinants of mothers' engagement in home visitation services. *Family Relations*, *52*(3), 271–278. Retrieved September 9 from www.jstor.org/stable/3700278

Minkovitz, C. S., O'Neill, K. M., & Duggan, A. K. (2016). Home visiting: A service strategy to reduce poverty and mitigate its consequences. *Academic Pediatric, 16*(3 Suppl), S105–111. https://doi.org/10.1016/j.acap.2016.01.005

Navaie-Waliser, M., Martin, S. L., Campbell, M. K., Tessaro, I., Kotelchuck, M., & Cross, A. W. (2000). Factors predicting completion of a home visitation program by high-risk pregnant women: The North Carolina Maternal Outreach Worker Program. *American Journal of Public Health, 90*(1), 121–124. https://doi.org/10.2105/ajph.90.1.121

Nurse-Family Partnership. (2019). *Nurses and mothers*. Nurse-Family Partnership,. Retrieved September 9 from https://www.nursefamilypartnership.org/wp-content/uploads/2018/11/Nurses-Mothers.pdf

O'Brien, R. A., Moritz, P., Luckey, D. W., McClatchey, M. W., Ingoldsby, E. M., & Olds, D. L. (2012). Mixed methods analysis of participant attrition in the nurse-family partnership. *Prevention Science, 13*(3), 219–228. https://doi.org/10.1007/s11121-012-0287-0

Olds, D. L. (2002). Prenatal and infancy home visiting by nurses: From randomized trials to community replication. *Prevention Science, 3*(3), 153–172.

Olds, D. L., Holmberg, J. R., Donelan-McCall, N., Luckey, D. W., Knudtson, M. D., & Robinson, J. (2014). Effects of home visits by paraprofessionals and by nurses on children: Follow-up of a randomized trial at ages 6 and 9 years. *JAMA Pediatrics, 168*(2), 114–121. https://doi.org/10.1001/jamapediatrics.2013.3817

Olds, D. L., Kitzman, H., Anson, E., Smith, J. A., Knudtson, M. D., Miller, T., Cole, R., Hopfer, C., & Conti, G. (2019). Prenatal and infancy nurse home visiting effects on mothers: 18-year follow-up of a randomized trial. *Pediatrics*, *144*(6). https://doi.org/10.1542/peds.2018-3889

Pearlin, L. I., & Schooler, C. (1978). The structure of coping. *Journal of Health and Social Behavior, 19*(1), 2–21.

Pomare, C., Long, J. C., Churruca, K., Ellis, L. A., & Braithwaite, J. (2020). Interprofessional collaboration in hospitals: A critical, broad-based review of the literature. *Journal of Interprofessional Care, 34*(4), 509–519. https://doi.org/10.1080/13561820.2019.1702515

Prince, J., & Austin, M. J. (2005). Inter-agency collaboration in child welfare and child mental health systems. *Social Work in Mental Health, 4*(1), 1–16.

Raikes, H., Green, B. L., Atwater, J., Kisker, E., Constantine, J., & Chazan-Cohen, R. (2006). Involvement in early head start home visiting services: Demographic predictors and relations to child and parent outcomes. *Early Childhood Research Quarterly*, *21*(1), 2–24. https://doi.org/10.1016/j.ecresq.2006.01.006

Reeves, S., Pelone, F., Harrison, R., Goldman, J., & Zwarenstein, M. (2017). Interprofessional collaboration to improve professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews*, *6*(6), Cd000072. https://doi.org/10.1002/14651858.CD000072.pub3

Regan, S., Laschinger, H. K. S., & Wong, C. A. (2016). The influence of empowerment, authentic leadership, and professional practice environments on nurses' perceived interprofessional collaboration. *Journal of Nursing Management*, *24*(1), E54–E61. https://doi.org/10.1111/jonm.12288

Sweet, M. A., & Appelbaum, M. I. (2004). Is home visiting an effective strategy? A meta-analytic review of home visiting programs for families with young children. *Child Development, 75*(5), 1435–1456.

Thorland, W., & Currie, D. W. (2017). Status of birth outcomes in clients of the Nurse-Family Partnership. *Maternal and Child Health Journal, 21*(5), 995–1001. https://doi.org/10.1007/s10995-017-2267-2

Towe, V. L., Leviton, L., Chandra, A., Sloan, J. C., Tait, M., & Orleans, T. (2016). Cross-sector collaborations and partnerships: Essential ingredients to help shape health and well-being. *Health Affairs, 35*(11), 1964–1969. https://doi.org/10.1377/hlthaff.2016.0604

Tung, G. J., Williams, V. N., Ayele, R., Shimasaki, S., & Olds, D. (2019). Characteristics of effective collaboration: A study of Nurse-Family Partnership and Child Welfare. *Child abuse & neglect*, *95*, 104028. https://doi.org/10.1016/j.chiabu.2019.104028

Valentine, M. A., Nembhard, I. M., & Edmondson, A. C. (2015). Measuring teamwork in health care settings: A review of survey instruments. *Medical Care, 53*(4), e16–e30.

Wagner, M., Spiker, D., Inman Linn, M., & Hernandez, F. (2003). Dimensions of parental engagement in home visiting programs: Exploratory study. *Topics in Early Childhood Special Education, 23*(4), 171–187. https://doi.org/10.1177/02711214030230040101

Williams, V. N., Brooks-Russell, A., McManus, B. M., Yost, E., Olds, D., & Tung, G. J. (2021a). National survey of nurse home visitor collaboration with health care and social services. *Public Health Nursing, 00*, 1–12. https://doi.org/10.1111/phn.12897

Williams, V. N., Franco, C. Y., Lopez, C. C., Allison, M. A., Olds, D. L., & Tung, G. J. (2021b). A qualitative study of mothers' perspectives on enrolling and engaging in an evidence-based nurse home visiting program. *Prevention Science*. https://doi.org/10.1007/s11121-021-01260-5