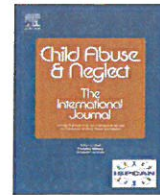


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Preventing child maltreatment: Examination of an established statewide home-visiting program



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ABSTRACT

Although home visiting has been used in many populations in prevention efforts, the impact of scaled-up home-visiting programs on abuse and neglect remains unclear. The objective of this study was to assess the impact of voluntary participation in an established statewide home-visiting program for socially high-risk families on child maltreatment as identified by Child Protective Services (CPS). Propensity score matching was used to compare socially high-risk families with a child born between January 1, 2008 and December 31, 2011 who participated in Connecticut's home-visiting program for first-time mothers and a comparison cohort of families who were eligible for the home-visiting program but did not participate. The main outcomes were child maltreatment investigations, substantiations, and out-of-home placements by CPS between January 1, 2008 and December 31, 2013. In the unmatched sample, families who participated in home-visiting had significantly higher median risk scores ($P < .001$). After matching families on measured confounders, the percentages of families with CPS investigations (21.1% vs. 20.9%, $P = .86$) were similar between the two groups. However, there was a 22% decreased likelihood of CPS substantiations (hazard ratio [HR] 0.78, 95% confidence interval [CI] 0.64–0.95) for families receiving home visiting. First substantiations also occurred later in the child's life among home-visited families. There was a trend toward decreased out-of-home placement (HR 0.73, 95% CI 0.53–1.02, $P = .06$). These results from a scaled-up statewide program highlight the potential of home visiting as an important approach to preventing child abuse and neglect.

1. Introduction

Major efforts to improve child well-being and ameliorate the impact of child maltreatment have relied on home-visiting interventions. In the U.S., more than 145,000 families with young children currently receive federally funded home visiting; when state and locally funded initiatives are included, the population served is estimated to be greater than 2 million families (Lanier, Maguire-Jack, & Welch, 2015; U.S. Department of Health & Human Services, 2016).

Home visiting is an evidence-based strategy in which families are engaged in their homes or communities by trained personnel (Duffee et al., 2017). Programs vary in target and scope though often focus on socially high-risk pregnant women or families with

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young children. Major expansions of home visiting have occurred over the last decade, particularly with the federal establishment of the Maternal, Infant and Early Childhood Home Visiting Program (MIECHV), allowing a greater number of high-risk families to be served in their communities across the U.S. The potential benefits of home visiting have been demonstrated by positive effects on the developmental, health, and educational outcomes of young children (Avellar & Supplee, 2013; Filene, Kaminski, Valle, & Cachat, 2013).

The effectiveness of home visiting on the prevention of child maltreatment, however, remains less clear. For instance, data from randomized controlled trials have shown a significant impact of home visiting on the occurrence of child maltreatment, including fewer reports and substantiations to Child Protective Services (CPS) in home-visited groups compared to controls (Olds et al., 1997; Zielinski, Eckenrode, & Olds, 2009). Similarly, a large quasi-experimental study assessing Kentucky's statewide home-visiting program found a significant impact on substantiated child maltreatment within the first year of life (Williams et al., 2017). In contrast, several other programs that have been scaled-up to provide home visiting to families in large geographic regions in the U.S. and New Zealand have not shown a significant effect on the occurrence of child maltreatment (Duggan et al., 2004, 2007; Vaithianathan, Wilson, Maloney, & Baird, 2016).

The discrepant impacts upon child maltreatment by home visiting programs may be due to a number of factors. For example, as interventions with strong support from randomized control trials are broadened to larger populations, challenges from rapid program expansion and population heterogeneity may erode program effects. Additionally, a recent meta-analysis showed programs' implementation factors, including training, supervision, and monitoring of fidelity, had a significant effect on child maltreatment outcomes (Casillas, Fauchier, Derkash, & Garrido, 2016).

Because home visiting continues to be viewed as an important service to prevent child maltreatment, clarifying the effectiveness of scaled-up programs on its occurrence is needed. Therefore, we sought to examine the effects of a scaled-up, statewide home-visiting program using a novel approach that linked data from the home-visiting program to that from the state's CPS agency. We compared CPS reports, substantiations and out-of-home placements in home-visited families who were sociodemographically similar to families who did not receive home-visiting services. This study represents one of the largest U.S. studies conducted to date to investigate the impact of home visiting on child maltreatment.

2. Methods

2.1. Study overview

We examined a longitudinal cohort of socially high-risk families in Connecticut who participated in a statewide home-visiting program for first-time mothers and a comparison cohort of families who were eligible for the home-visiting program but did not participate. Screening and enrollment data were linked to the state's CPS records. Demographics and reported risk factors were used to match intervention and comparison groups.

Three CPS-related outcomes were ascertained: 1) investigated reports of maltreatment, 2) substantiated reports of maltreatment, and 3) out-of-home placements.

This study was approved by the Institutional Review Boards of the Yale School of Medicine, the University of Hartford, and the State of Connecticut's Department of Children and Families.

2.2. Intervention

The Nurturing Families Network (NFN) home-visiting program provides voluntary services to optimize parenting and help address vulnerabilities throughout early childhood development. The program has gradually increased the breadth of services offered since it began in 1995 (Foley-Schain, Finholm, & Leventhal, 2011). During the study period, NFN sought to screen every first-time mother in the state either prenatally or in the early postnatal period to identify socially high-risk families. Screening was conducted by NFN intake coordinators at obstetricians' offices, community partner sites, and birthing hospitals.

Families were able to receive home visiting until the child reached five years of age. Visits were conducted in English or Spanish. On average, families received two home visits per month according to program standards. During the study period, retention in the home visiting program ranged between 60 and 70% at six months and between 40 and 50% at one year (Joslyn & Hughes, 2012).

Home visits followed the Parents as Teachers (PAT) curriculum (Winter & McDonald, 1999), which is approved as an evidence-based model of home visiting by the Department of Health and Human Services (Avellar & Supplee, 2013). Home visitors had a minimum of a high school education and were supervised by social workers with a master's degree. Each program was evaluated annually to determine whether established quality benchmarks had been met, which included: number of families recruited, retention rates, and number of visits received per family.

2.3. Study sample

The study sample was comprised of socially high-risk families who had a child with a birthdate between January 1, 2008 and December 31, 2011. Socially high-risk births were identified by the Revised Early Identification (REID) screening instrument, which was adapted from the Early Identification instrument (Duggan et al., 2000). The REID assesses 17 factors known to increase the risk of maltreatment, including teen motherhood, single motherhood, social isolation, and housing instability (Duggan et al., 2000). A family was determined to be high-risk if there was endorsement of any three of 17 risk factors or endorsement of a history of

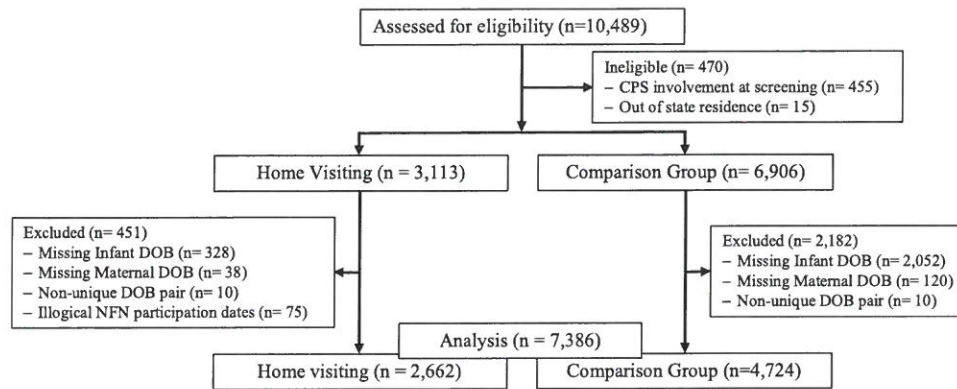


Fig. 1. Consort Diagram.

substance abuse, psychiatric care, depression or marital/family problems. Total risk score was calculated by summing the number of positive risk factors.

Fig. 1 shows the number of families who were eligible based on REID screening, as well as the number of families who were ineligible because they were involved with CPS at the time of screening or resided out of state.

Among eligible families, we reviewed NFN administrative records to identify families in the treatment group. All families with documented enrollment in NFN, as determined by start and exit dates and regardless of the duration of participation, were considered for inclusion in the treatment group (i.e., home-visiting [HV] families). Families who left the HV program and reentered were also included. We excluded families who were reported to have enrolled in NFN, but who did not have logical dates to verify participation (e.g., families with an NFN exit date prior to a start date). Families were also excluded if either the mother's or child's date of birth was missing (both dates were necessary to link the NFN records with those from CPS).

For the comparison group (i.e., families without NFN involvement), we included families who declined NFN services and those unable to enroll because the social worker could not engage the family or because there was no opening in the family's local NFN program. Consistent with the HV group, families were excluded if either the mother or child's date of birth was missing; this included many families who were screened prenatally because the child's date of birth was not available.

2.4. Data linkage

CPS data were collected for the study sample from January 1, 2008 to December 31, 2013. CPS records were retrieved using only the birthdates for the mother and child. One-to-one deterministic matches were identified between CPS records to NFN records by perfect match of both the mother and child's birthdates (Roos & Wajda, 1991; Tromp, Ravelli, Bonsel, Hasman, & Reitsma, 2011).

Prior to data linkage, three steps were taken to address data quality. First, non-unique mother-child birthdate pairs were excluded from the HV and comparison groups. Second, CPS case files were queried to confirm that the appropriate data were available for linkage. Review of CPS case files showed that 100% of files had the child's date of birth and 98% of files had the mother's date of birth. Third, the likelihood of a potential mismatch (e.g., two mother-child pairs having an exact match of paired birthdates) that might result in a false linkage between a screened family and a CPS report was calculated to be less than 1% (Office of Vital Records, 2008–2011).

2.5. Outcomes

CPS records included the following: child's age at the time of the CPS investigation, whether the report was substantiated, type of suspected and substantiated maltreatment, and whether the child was placed in out-of-home custody. CPS follow-up time was calculated as the time between the child's date of birth and the end of the CPS' monitoring window (i.e., December 31, 2013).

Primary outcomes included investigated reports of maltreatment, substantiations of maltreatment, out-of-home placements, and the time to each of these events. Secondary outcomes included types of maltreatment for first substantiation, duration of out-of-home placement, and percentage of out-of-home placements with reunification. Maltreatment type was categorized as 1) physical, medical, emotional, educational, or moral neglect; and 2) physical abuse. Sexual abuse was not included as a secondary outcome because there were very few cases of sexual abuse within the cohort.

2.6. Statistical analysis

We used descriptive statistics to characterize the sample at baseline. Differences according to NFN participation were assessed with χ^2 tests for categorical variables and 2-tailed *t* or Wilcoxon rank sum tests for continuous variables.

To control for confounding associated with voluntary participation in home visiting (i.e., selection bias), we generated propensity scores to reflect a family's conditional probability of receiving NFN home visiting based on sociodemographic characteristics and

REID scores by fitting a multivariable logistic regression model with covariates associated with both NFN participation and the CPS outcome of interest. From the REID screening instrument, we included covariates related to maternal age, marital status, education, presence of cognitive deficit, history of mental illness (e.g., depression), substance abuse, partner's employment status, marital or family problems, lack of or poor prenatal care, unstable housing, and total number of REID risk factors. Additionally, we included CPS follow-up time.

We assessed the discrimination and calibration of the propensity-score models using C-statistics and goodness-of-fit tests. C-statistics measure a model's ability to predict treatment status (i.e., NFN participation). Additional diagnostics included an evaluation of histograms (stratified by NFN participation) for the propensity scores and plotting the observed versus expected outcomes from the Hosmer-Lemeshow goodness-of-fit test. All logistic regression models were found to have acceptable C-statistics ($\geq .70$) and good fit (Hosmer-Lemeshow P value $\geq .05$; (Allison, 2012; Hosmer & Lemeshow, 2000; Schneeweiss et al., 2001).

We then matched families on propensity scores using a SAS greedy algorithm macro, designed to match on as many as five digits (Parsons, 2001). Further details on the methods and rationale for propensity-score matching in observational research are published elsewhere (Cochran, 1968; d'Agostino, 1998; Parsons, 2001; Pasta, 2000).

Bivariate associations between NFN participation and CPS outcomes in the unmatched and matched samples were then assessed using χ^2 tests. To account for the timing at which substantiations and out-of-home placements occurred, we used Cox proportional hazards regression to generate hazard ratios (HRs). Similarly, we assessed time to *first* substantiation and out-of-home placement using Kaplan-Meier curves.

All analyses were performed using SAS software (version 9.3; SAS Institute Inc., Cary, NC). A two-sided statistical significance level of 0.05 was applied to all analyses.

2.7. Sampling frame analysis

To assess for potential bias in the sampling frame, we conducted the following secondary analyses:

First, we assessed the REID risk factor profile of families who were excluded because of missing birth date, either maternal or child to determine whether it was significantly different from the risk profile of those included in the study. For both HV and comparison families, there was greater risk in excluded families versus included families (data not shown).

Second, the absence of comparison families who were screened prenatally represents an imbalance between the comparison and HV groups. Thus, we compared CPS outcomes between the two groups after excluding prenatally screened families from the HV group. There were no substantive changes to the results.

3. Results

3.1. Characteristics of the sample

As shown in Fig. 1, during the study period, 10,489 families were screened as high-risk by NFN, and 10,019 were eligible for the study. Of eligible families, 7386 families (70.4%) were included in the final analysis: 2662 in the HV group (36.0% of included) and 4724 in the comparison group (64.0%). Of the 2633 excluded families, the largest excluded group was comparison families who were screened prenatally ($n = 2052$; 77.9%).

Characteristics in the unmatched sample for the HV versus comparison families are shown in Table 1. Home-visiting families had

Table 1
Demographic and Clinical Characteristics in the Unmatched Sample.

	Home Visiting		P
	Yes (n = 2,662)	No (n = 4,724)	
Maternal REID Screen, median (IQR), score	4.0 (3.0–6.0)	4.0 (3.0–5.0)	< .001
Single, separated, or divorced, n (%)	2380 (90.0)	4127 (87.4)	.001
Education ≤ 12 years, n (%)	1115 (45.8)	1,229 (31.2)	< .001
Cognitive deficit, n (%)	129 (5.4)	92 (2.1)	< .001
History of psychiatric care, n (%) ^a	589 (24.5)	1019 (23.8)	.49
History of depression, n (%) ^a	956 (40.0)	1597 (37.1)	.02
History of substance abuse, n (%) ^a	371 (15.3)	671 (15.3)	.98
Marital or family problems, n (%) ^a	948 (41.0)	1050 (26.7)	< .001
No, late (> 12 weeks), or poor prenatal care, n (%)	671 (27.2)	1042 (24.0)	.003
Unstable housing, n (%)	433 (17.1)	271 (6.0)	< .001
≤ 18 years, n (%)	847 (32.2)	1123 (23.9)	< .001
Maternal age, mean (SD), years	22.1 (5.3)	23.2 (5.5)	< .001
CPS follow-up time, median (IQR), years	4.2 (3.1–5.0)	4.2 (3.0–5.0)	.99
Home visiting duration, median (IQR), months ^b	11.7 (4.3–31.5)	–	–

Abbreviations: CPS, Child Protective Services; IQR, interquartile range; REID, Revised Early Identification; SD, standard deviation.

^a Screening tool questions requiring only one other risk factor for family to be considered high-risk by Nurturing Families Network.

^b Calculated for home-visiting families with one start and one exit date, $n = 2,440$.

Table 2
Demographic and Clinical Characteristics in the Matched Sample.

	Home Visiting		P
	Yes (n = 2,280)	No (n = 2,280)	
Maternal REID Screen, median (IQR), score	4.0 (3.0–5.0)	4.0 (3.0–5.0)	.41
Single, separated, or divorced, n (%)	2043 (89.7)	2021 (88.8)	.29
Education ≤ 12 years, n (%)	864 (41.7)	873 (42.4)	.66
Cognitive deficit, n (%)	78 (3.8)	81 (3.9)	.81
History of psychiatric care, n (%) ^a	462 (22.4)	434 (21.2)	.35
History of depression, n (%) ^a	765 (37.1)	736 (35.9)	.44
History of substance abuse, n (%) ^a	307 (14.7)	311 (14.9)	.84
Marital or family problems, n (%) ^a	706 (35.8)	704 (36.3)	.72
No, late (> 12 weeks), or poor prenatal care, n (%)	531 (25.1)	542 (25.6)	.71
Unstable housing, n (%)	236 (10.8)	231 (10.7)	.84
≤ 18 years, n (%)	668 (29.5)	691 (30.5)	.44
Maternal age, mean (SD), years	22.3 (5.4)	22.2 (5.2)	.33
CPS follow-up time, median (IQR), years	4.1 (3.1–5.0)	4.2 (3.1–5.0)	.45
Home visiting duration, median (IQR), months ^b	11.7 (4.2–31.4)	–	–

Abbreviations: CPS, Child Protective Services; IQR, interquartile range; REID, Revised Early Identification; SD, standard deviation.

^a Screening tool questions requiring only one other risk factor for family to be considered high-risk by Nurturing Families Network.

^b Calculated for home-visiting families with one entrance and one exit date, n = 2,105.

significantly higher total median REID scores versus comparison families. Mothers in HV families were more likely to be single, lack a high school education, have a cognitive deficit, have a history of depression, have marital or family problems, have unstable housing, and be younger. In contrast, there were no statistically significant differences between the HV and comparison mothers' reported history of psychiatric care or substance abuse. Home-visiting and comparison families had no difference in median CPS follow-up time. Home-visiting families participated in NFN for a median of 11 months.

After propensity-score matching, HV and comparison families were no longer significantly different on any measured risk factor (Table 2). Given the significant differences in baseline risk assessments, results presented hereafter represent matched data unless otherwise noted.

3.2. CPS investigated reports

The percentage of families with at least one CPS investigated report was not statistically different in the HV group vs. the comparison group (21.1% vs. 20.9%, $P = .86$, Table 3). Of families in the HV group with at least one investigation, 39.4% of reports occurred during the time of NFN enrollment.

3.3. CPS substantiations

The percentage of families with at least one substantiated report was lower in the HV group than in the comparison group (7.8% vs. 9.9%, $P = .01$, Table 3). As shown in Table 4, when first substantiations were examined, HV families had fewer cases of substantiated neglect (7.5% v 9.7%, $P = .007$), but there was no statistically significant difference in the percentage of families with substantiated physical abuse (0.4% v 0.2%, $P = .40$).

Table 3
Child Maltreatment Outcomes.

	Unmatched		P	Matched		P
	Home Visiting			Home Visiting		
	Yes (n = 2,662)	No (n = 4,724)		Yes (n = 2,280)	No (n = 2,280)	
CPS investigated reports						
Any investigated report, n (%)	600 (22.5)	915 (19.4)	.001	482 (21.1)	477 (20.9)	.86
CPS substantiations						
Any substantiation, n (%)	229 (8.6)	385 (8.2)	.50	177 (7.8)	225 (9.9)	.01
Out-of-home placement, n (%)	87 (3.2)	140 (3.0)	.47	61 (2.7)	83 (3.6)	.06
Length of out-of-home placement, median (IQR), months	16.5 (6.8–24.7)	14.7 (7.8–24.0)	.99	17.0 (7.9–25.3)	13.7 (6.1–23.0)	.35
Family reunification following out-of-home placement, n (%)	30 (34.5)	60 (42.9)	.21	23 (37.7)	39 (47.0)	.27

Abbreviations: CPS, Child Protective Services; IQR, interquartile range.

Table 4
Type of Child Maltreatment Substantiated by CPS.

	Unmatched		P	Matched		P
	Home Visiting			Home Visiting		
	Yes (n = 2,622)	No (n = 4,724)		Yes (n = 2,280)	No (n = 2,280)	
Neglect, n (%)	219 (8.2)	375 (7.9)	.66	171 (7.5)	222 (9.7)	.007
Physical abuse, n (%)	11 (0.4)	13 (0.3)	.32	8 (0.4)	5 (0.2)	.40

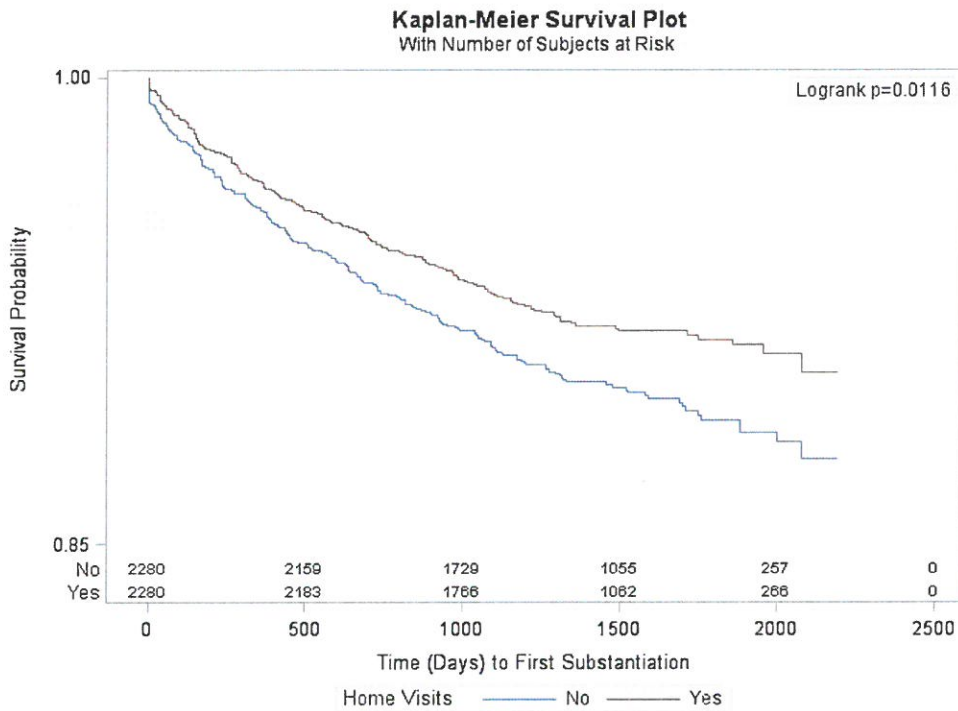


Fig. 2. Propensity-Matched Kaplan-Meier Survival Plots (with number of families at risk at each time point) for Time to First Substantiation by Home-Visiting Status.

Table 5
Cox Proportional Hazards of Time to Event in Unmatched and Matched Samples.

	Unmatched		Matched	
	Hazard Ratio (95% CI)	P	Hazard Ratio (95% CI)	P
Substantiated CPS report	1.06 (0.90–1.24)	.52	0.78 (0.64–0.95)	.01
Out-of-home placement	1.10 (0.85–1.44)	.47	0.73 (0.53–1.02)	.06

Abbreviations: CI, confidence interval; CPS, Child Protective Services.

For HV families, if a first substantiation occurred, it occurred later in the child’s life (Fig. 2). As shown in Table 5, HV vs. comparison families experienced a 22% reduction in the likelihood of substantiation (HR 0.78, 95% CI 0.64–0.95).

3.4. Out-of-home placement

A smaller percentage of HV families had an out-of-home placement than comparison families (2.7% vs. 3.6%), but this result was not statistically significant (P = .06, Table 3). There was also no significant difference in length of out-of-home placement once initiated (median [IQR] 17.0 [7.9–25.3] vs. 13.7 [6.1–23.0] months, P = .35) or in the percentage of families who were reunited following out-of-home placement (37.7% v 47.0%, P = .27). The likelihood of out-of-home placement for HV families versus comparison families was not statistically significant (HR 0.73, 95% CI 0.53–1.02, Table 5, Fig. 3).

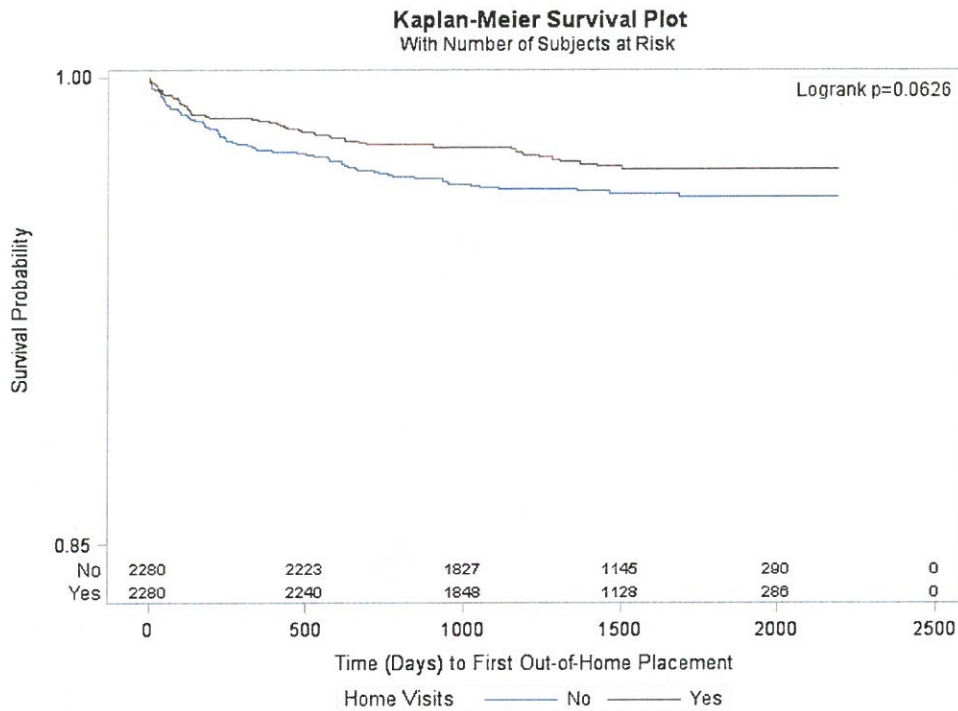


Fig. 3. Propensity-Matched Kaplan-Meier Survival Plots (with number of families at risk at each time point) for Time to First Out-of-Home Placement by Home-Visiting Status.

4. Discussion

In this study of a scaled-up, statewide home-visiting program, we linked data on mother-child pairs who were eligible for home visiting with data from the state’s child protective service agency and found that home visiting was associated with a significantly lower occurrence of substantiated child maltreatment but not out-of-home placements. After matching on families’ baseline risk assessments, home visiting was associated with a 22% decrease in the likelihood of substantiated reports, with specific impact on the occurrence of neglect but not physical abuse. Moreover, for HV families who did have a substantiated report, this event occurred at a later age than for the comparison group.

A decrease in substantiated child maltreatment for HV families in this study is in line with the demonstrated potential for home visiting to prevent child maltreatment shown in randomized control trials and the recent assessment of Kentucky’s scaled-up home visiting program (Olds et al., 1997; Williams et al., 2017; Zielinski et al., 2009). In contrast, results from other scaled-up home-visiting programs have shown no effect of home visiting on the occurrence of child maltreatment or even an increase in child maltreatment among participating families (Duggan et al., 2004, 2007; Vaithianathan et al., 2016). The significant impact demonstrated in our study may be due to NFN’s long track record within Connecticut prior to the study window; similarly, in Kentucky, analysis of their home visiting program showed marked decrease in substantiated maltreatment years after the home visiting program was established statewide (Williams et al., 2017). Additionally, while NFN HV families had higher REID risk scores than comparison families in the unmatched sample, NFN does not receive referrals directly from CPS as some other home-visiting programs do, and so may not be serving families at the highest risk (Vaithianathan et al., 2016).

Previous studies have identified surveillance bias as a potential barrier to detecting the impact of home-visiting on reports of child maltreatment (Olds, Henderson, Kitzman, & Cole, 1995; Roberts, Kramer, & Suissa, 1996). Further research to specifically assess surveillance bias in home visiting, however, has found only a limited effect of surveillance bias among families actively receiving services (Chaffin & Bard, 2006; Matone et al., 2013). In our study, while there were similar percentages of families with CPS investigated reports for HV and comparison families, home visiting still showed substantial benefits as noted by the lower percentage of HV families with a substantiated CPS report.

Few studies have assessed the ability of home visiting to impact out-of-home placement. In our study, although the hazard ratio for out-of-home placement indicated a 27% decrease in the HV group vs. the comparison group, this result was not statistically significant, which may have been influenced by the rare frequency of this outcome.

We believe that by adhering to the principles of intention-to-treat, we have strengthened our findings by limiting the potential bias of restrictive inclusion criteria. Accordingly, all families who agreed to home visiting and had logical dates to verify participation, regardless of their duration of exposure to home visiting, were included in the intervention arm.

This study has at least four limitations. First, this is a retrospective observational study and not a randomized control trial, the gold-standard for demonstrating causal impact and limiting confounders (FDA, 1997). Several methods, however, were employed to

minimize bias in this observational study, including the use of propensity-score matching to limit differences between the families being compared and using few exclusion criteria. While propensity-score minimizes the impact of measured differences between groups, it is possible that bias persisted due to unmeasured variables.

Second, despite having few exclusion criteria, 2633 families were excluded, which represented 26% of the potential sample, and some of the exclusions may have biased the results. As previously noted, the excluded families did have higher risk profile scores as measured by the REID for both HV and comparison families. Additionally, when we excluded prenatally enrolled HV families from the analysis to account for potentially unmeasured factors in prenatally screened comparison families (the largest excluded group), the results were essentially unchanged.

Third, use of administrative data for research purposes has limitations. Data integrity may be variable, and data content may be limited. For example, in this study, race was only available for families with a CPS report, and, therefore, this variable was not used in the analysis. Additionally, we did not have access to families' identifying information beyond birthdates to confirm the integrity of matching. Reassuringly, the percentage of HV families with CPS reports was similar to the results of a published report on the same HV program that used a different method of linkage when length of monitoring period is accounted for (Duffy, Hughes, Asnes, & Leventhal, 2014).

Finally, a limitation in quantifying the prevention of child maltreatment is the absence of a single best measure to define child maltreatment. Using reports to CPS requires unbiased involvement of mandated reporters within the study groups, an assumption that may be inaccurate for HV participants versus a control group. It is possible that if HV involvement was disclosed to CPS during an investigation, HV families may have experienced a positive bias in decision making by CPS case workers resulting in fewer substantiated reports. If such an effect were present in our data, it was not sufficient to uniformly bias all CPS outcomes as indicated by the non-significant difference in out-of-home placement. Additional research is needed to clarify whether disclosing information about home-visiting participation to CPS might affect CPS' decision making; this research would help clarify the independent impact of home visiting on maltreatment.

In summary, this study demonstrated a significant decrease in substantiations of child maltreatment for families in a scaled-up, statewide home-visiting program. These results highlight the importance of home visiting in child abuse prevention.

Disclaimer

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Office of Early Childhood of the State of Connecticut.

Conflicts of interest disclosures

JML has received funding from the Office of Early Childhood to support a home-visiting program and to provide partial support for the data analysis of this project. KFS was employed by the Office of Early Childhood and served as executive director of NFN during study period.

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References

- Allison, P. D. (2012). *Logistic regression using SAS: Theory and application*. SAS Institute.
- Avellar, S. A., & Supplee, L. H. (2013). Effectiveness of home visiting in improving child health and reducing child maltreatment. *Pediatrics*, *132*(Suppl. 2), S90–S99.
- Casillas, K. L., Fauchier, A., Derkash, B. T., & Garrido, E. F. (2016). Implementation of evidence-based home visiting programs aimed at reducing child maltreatment: A meta-analytic review. *Child Abuse and Neglect*, *53*, 64–80.
- Chaffin, M., & Bard, D. (2006). Impact of intervention surveillance bias on analyses of child welfare report outcomes. *Child Maltreatment*, *11*(4), 301–312.
- Cochran, W. G. (1968). The effectiveness of adjustment by subclassification in removing bias in observational studies. *Biometrics*, *24*(2), 295–313.
- d'Agostino, R. B. (1998). Tutorial in biostatistics: Propensity score methods for bias reduction in the comparison of a treatment to a non-randomized control group. *Statistics in Medicine*, *17*(19), 2265–2281.
- Duffee, J. H., Mendelsohn, A. L., Kuo, A. A., Legano, L. A., Earls, M. F., Council On Community, P., et al. (2017). Early childhood home visiting. *Pediatrics*, *140*(3).
- Duffy, J. Y., Hughes, M., Asnes, A. G., & Leventhal, J. M. (2014). Child maltreatment and risk patterns among participants in a child abuse prevention program. *Child Abuse and Neglect*, *44*, 184–193.
- Duggan, A., Caldera, D., Rodriguez, K., Burrell, L., Rohde, C., & Crowne, S. S. (2007). Impact of a statewide home visiting program to prevent child abuse. *Child Abuse and Neglect*, *31*(8), 801–827.
- Duggan, A., McFarlane, E., Fuddy, L., Burrell, L., Higman, S. M., Windham, A., et al. (2004). Randomized trial of a statewide home visiting program: Impact in preventing child abuse and neglect. *Child Abuse and Neglect*, *28*(6), 597–622.
- Duggan, A., Windham, A., McFarlane, E., Fuddy, L., Rohde, C., Buchbinder, S., et al. (2000). Hawaii's healthy start program of home visiting for at-risk families: Evaluation of family identification, family engagement, and service delivery. *Pediatrics*, *105*(1 Pt. 3), 250–259.
- FDA (1997). *International conference on harmonization: Guidelines on general considerations for clinical trials*. FDA, Federal Register 66113–66119.
- Fileene, J. H., Kaminski, J. W., Valle, L. A., & Cachat, P. (2013). Components associated with home visiting program outcomes: A meta-analysis. *Pediatrics*, *132*(Suppl. 2), S100–9.
- Foley-Schain, K., Finholm, V., & Leventhal, J. M. (2011). Building a statewide home visiting program from 2 to 42 sites: A state agency's perspective. *Child Abuse and Neglect*, *35*(4), 283–286.
- Hosmer, D., & Lemeshow, S. (2000). *Applied logistic regression*. Wiley series in probability and statistics texts and references section. New York: Wiley.

- Joslyn, A., & Hughes, M. (2012). *Nurturing families network: 2012 annual evaluation report*. Hartford, CT: Center for Social Research, University of Hartford.
- Lanier, P., Maguire-Jack, K., & Welch, H. (2015). A nationally representative study of early childhood home visiting service use in the United States. *Maternal and Child Health Journal*, 19(10), 2147–2158.
- Matone, M., Curtis, C., Chesnokova, A., Yun, K., Kreider, A., Curtis, M., et al. (2013). *Evaluation of maternal and child home visitation programs: Lessons from Pennsylvania*. Philadelphia, PA: PolicyLab Center to Bridge Research, Practice and Policy, The Children's Hospital of Philadelphia Research Institute.
- Olds, D., Henderson, C. R., Jr, Kitzman, H., & Cole, R. (1995). Effects of prenatal and infancy nurse home visitation on surveillance of child maltreatment. *Pediatrics*, 95(3), 365–372.
- Olds, D. L., Eckenrode, J., Henderson, C. R., Jr, Kitzman, H., Powers, J., Cole, R., et al. (1997). Long-term effects of home visitation on maternal life course and child abuse and neglect. Fifteen-year follow-up of a randomized trial. *The Journal of the American Medical Association*, 278(8), 637–643.
- Parsons, L. S. (2001). Reducing bias in a propensity score matched-pair sample using greedy matching techniques. *Proceedings of the Twenty-sixth Annual SAS Users Group International Conference* (pp. 214–226). edited by, SAS Institute Inc.
- Pasta, D. J. (2000). Using propensity scores to adjust for group differences: Examples comparing alternative surgical methods. *25th Annual SAS Users Group International Conference* edited by, pp.
- Office of Vital Records (2008).** *Annual registration reports 2008-2011*, Accessed at. Connecticut Department of Public Health <http://portal.ct.gov/dph/Health-Information-Systems-Reporting/Hisrhome/Vital-Statistics-Registration-Reports%20>.
- Roberts, I., Kramer, M. S., & Suissa, S. (1996). Does home visiting prevent childhood injury? A systematic review of randomised controlled trials. *British Medical Journal*, 312(7022), 29–33.
- Roos, L., & Wajda, A. (1991). Record linkage strategies. *Methods of Information in Medicine*, 30(2), 117–123.
- Schneeweiss, S., Seeger, J. D., Maclure, M., Wang, P. S., Avorn, J., & Glynn, R. J. (2001). Performance of comorbidity scores to control for confounding in epidemiologic studies using claims data. *American Journal of Epidemiology*, 154(9), 854–864.
- Tromp, M., Ravelli, A. C., Bonsel, G. J., Hasman, A., & Reitsma, J. B. (2011). Results from simulated data sets: Probabilistic record linkage outperforms deterministic record linkage. *Journal of Clinical Epidemiology*, 64(5), 565–572.
- U.S. Department of Health and Human Services (2016).** *Demonstrating improvement in the maternal, infant, and early childhood home visiting program* Accessed at <https://mchb.hrsa.gov/sites/default/files/mchb/MaternalChildHealthInitiatives/HomeVisiting/pdt/reportcongress-homevisiting.pdf>.
- Vaithianathan, R., Wilson, M., Maloney, T., & Baird, S. (2016). *The impact of the family start home visiting programme on outcomes for mothers and children: a quasi-experimental study*. Wellington, New Zealand: Ministry for Social Development.
- Williams, C. M., Cprek, S., Asaolu, I., English, B., Jewell, T., Smith, K., et al. (2017). Kentucky health access nurturing development services home visiting program improves maternal and child health. *Maternal and Child Health Journal*, 21(5), 1166–1174.
- Winter, M., & McDonald, D. (1999). Parents as teachers. *The Future of Children*, 9(1), 179–189.
- Zielinski, D. S., Eckenrode, J., & Olds, D. L. (2009). Nurse home visitation and the prevention of child maltreatment: impact on the timing of official reports. *Development and Psychopathology*, 21(02), 441–453.