

Projected Outcomes of Nurse-Family Partnership Home Visitation During 1996–2013, USA

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Abstract Nurse-Family Partnership (NFP) targets intensive prenatal and postnatal home visitation by registered nurses to low-income first-time mothers. Through 2013, 177,517 pregnant women enrolled in NFP programs. This article projects how NFP will affect their lives and the lives of their babies. NFP has been evaluated in six randomized trials and several more limited analyses of operational programs. We systematically reviewed evaluation findings on 21 outcomes and calculated effects on three more. We added outcome data from the NFP national data system and personal communications that filled outcome data gaps on some trials. We assumed effectiveness in replication declined by 21.8 %, proportionally with the decline in mean visits per family from trials to operational programs. By 2031, NFP program enrollments in 1996–2013 will prevent an estimated 500 infant deaths, 10,000 preterm births, 13,000 dangerous closely spaced second births, 4700 abortions, 42,000 child maltreatment incidents, 36,000 intimate partner violence incidents, 90,000 violent crimes by youth, 594,000 property and public order crimes (e.g., vandalism, loitering) by youth, 36,000 youth arrests, and 41,000 person-years of youth substance abuse. They will reduce smoking during pregnancy, pregnancy complications, childhood injuries, and use of subsidized child care; improve language development; increase breast-feeding; and raise

compliance with immunization schedules. They will eliminate the need for 4.8 million person-months of child Medicaid spending and reduce estimated spending on Medicaid, TANF, and food stamps by \$3.0 billion (present values in 2010 dollars). By comparison, NFP cost roughly \$1.6 billion. Thus, NFP appears to be a sound investment. It saves money while enriching the lives of participating low-income mothers and their offspring and benefiting society more broadly by reducing crime and safety net demand.

Keywords Birth outcomes · Birth spacing · Crime · Medicaid · Systematic review

Nurse-Family Partnership (NFP) is a program of intensive prenatal and postnatal home visitation by registered nurses. It targets low-income mothers and their first children. Visits start prenatally and ideally continue through age 2; 25–30 home visits over 17 months are typical.

NFP's goals are to help parents improve the following: (1) prenatal health and pregnancy outcomes, (2) child health and development through more sensitive and competent care, and (3) parental life-course by developing and fulfilling a vision for their future, planning future pregnancies, completing educations, and finding work (Olds et al. 2002). Prenatally, NFP focuses on improving diet; reducing alcohol, tobacco, and other drug use during pregnancy; coordinating prenatal care; identifying pregnancy complications and treating them early; and helping expectant mothers plan their future (Kitzman et al. 1997). Postnatal priorities shift to assuring that the baby has a safe and healthy home; improving child physical care, emotional care, play skills, and communication skills that promote developmental gains; encouraging breast-feeding; maintaining maternal health behavior gains; reducing domestic violence (an issue given greater attention after the first

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randomized trial); and setting and achieving personal life-course goals.

Reviews of social service programs (e.g., Promising Practices Network <http://www.promisingpractices.net/program.asp?programid=16>, Lee et al. 2012; Miller and Levy 2000) consistently conclude that strong evidence shows NFP works. Recruitment for the program's first randomized controlled trial began in Elmira, NY, in 1978 (Olds et al. 1986). Program model developers conducted additional trials in Denver and Memphis (Kitzman et al. 1997; Olds et al. 2002). These trials tracked participants longitudinally. Independent trials in Orange County, California, Louisiana, and the Netherlands added supporting evidence on short-term effects (Mejdoubi et al. 2014; Nguyen et al. 2003; Sonnier 2007). Less robust evaluations also are accumulating on NFP effectiveness in broad-based implementation (e.g., Rubin et al. 2011).

Lee et al. (2012) used meta-analytic techniques to assess eight outcomes across the three trials by NFP's developers. This article is broader. It provides a systematic review of findings on 21 outcomes including 10 with evidence from independent trials or operational programs. It adjusts all outcomes downward to account for imperfect fidelity in replication.

NFP began program replication in 1996. Unlike many operational programs, NFP replication is highly regimented and closely monitored (NFP National Service Office 2011; Olds et al. 2013, 2002). Use of the NFP model and name is limited to implementing agencies that contract with the NSO, participate in centralized training and extensive reporting (including longitudinal data by client), pay fees to the NSO to administer the data system and monitor quality, and comply with 18 quality elements including standards governing maximum case loads of nurses and supervisors, time spent on NFP's six domains, and nurse qualifications. NSO trains all nurse administrators, nurse supervisors, and nurse home visitors. NSO regional staff talk with state program coordinators at least weekly. Model improvements are evaluated in rigorous pilot studies (e.g., Ingoldsby et al. 2013), then rolled out to all sites.

By December 2013, 177,517 pregnant women enrolled in operational NFP programs (NFP National Service Office 2014). Online Table 1 describes the enrollees. Estimated costs were \$8742 per family served (Karoly and Bigelow 2005) and \$1.55 billion total (in 2010 dollars). This article aims to estimate how NFP will affect their lives and the lives of their babies, with future research planned on the associated return on investment.

Between Fiscal Years 2010 and 2014, the federal Maternal, Infant, and Early Childhood Home Visiting (MIECHV) Program provided \$1.5 billion in funding to expand evidence-based home visiting programs. NFP programs received perhaps one quarter of all MIECHV funding. Thus, estimates of

NFP's outcomes can inform and bolster periodic reauthorization discussions.

Methods

To identify evaluations, we contacted NFP program model developers, replicators, and NSO staff and searched the literature. We identified 39 evaluation reports on NFP spread over time and place. This included 23 reports on the three randomized trials by the program model's developers. We extracted effectiveness estimates for 21 outcomes and added evidence captured by the NFP NSO's mandatory reporting system on six of them. Randomized trials by the program model's developers provided all published evidence on eight of the outcomes. We computed impacts on three additional outcomes—preterm second births, subsidized child care, and Medicaid spending per child recipient—from documented impacts.

Table 1 summarizes the randomized trials and rates their quality. It shows enrollment by arm. Both Elmira and Memphis included arms that only received prenatal visits. Postnatal outcomes were not tracked in Memphis for this arm and the associated control group.

Louisiana trial data are less reliable than data from other trials because of heavy early dropout and loss to follow-up. Documentation is incomplete (simply a list of significant findings) and study staff refused to provide access to unpublished supporting tables. The Orange County trial's birth-outcome evaluation was conducted early, before some pregnancies reached term. Planned Orange County follow-up data were not collected at age 1, and county staff were unable to provide birth outcomes for mothers not included in the published report. We excluded a German trial because it did not use nurses as its home visitors. As in the paraprofessional visitor cohort of the Denver trial (Olds et al. 2002), NFP delivery by German social workers and midwives had minimal effectiveness (Sandner 2013a, b).

This article looks across trials to decide which outcomes are assured and which are tentative. Some outcomes, however, only were measured in recent trials or time periods. For example, child psychological assessments first used in Memphis suggested NFP-associated improvements. That finding led to a more probing assessment in Denver which pinpointed the improvements. Such evolution prevents cross-trial comparison. As the last row in Table 1 shows, another source of nonequivalence is the variation in follow-up time between trials, notably in Elmira where follow-ups were spaced by 8–10 years.

The replication studies on operational programs use quasi-experimental designs. They compare outcomes for NFP mothers to outcomes for other mothers. Their quality is reduced by imperfect comparison group matching. Rubin et al.

Table 1 Characteristics and Quality of Randomized Nurse-Family Partnership Trials

Site	Denver 1994–1995	Elmira 1978–1980	Louisiana 1999–2000	Memphis 1990–1991	Netherlands ^b 2006–2009	Orange County ^c 2000
Enrollment	235	216 (70) ^a	241; 152 with ≥1 visit	458	237	104
Nurse-Visited, Prenatal	235	116 ^a	106; 69 with ≥1 visit	228	237	N/A
Nurse-Visited, Post-natal	255	184 (105) ^a	116; 88 with ≥1 visit	681	223	121
Comparison Group, Prenatal	255	184 ^a	116; 88 with ≥1 visit	515	223	N/A
Comparison Group, Post-natal	87 %	62 %	93 %	97 %	82 %	100 %
Unmarried	95 %	61 %	100 %	85 %	71 % not working	100 %
Low Income	15 %	11 %	53 %	92 %	7 %	0 %
Black	49 %	0 %	44 %	0 %	8 %	100 %
Hispanic or Creole	0 %	0 %	0 %	0 %	15 %	0 %
Asian	36 %	89 %	3 % ^d	8 %	54% ^e	0 %
White Non-Hispanic	9	19 (23 underway)	1	12 (17 underway)	Birth	Birth
Archival Data Through Age	0, 1, 2, 4, 6, 9 years	0, 1, 2, 4, 15, 19, 23 years	0, 6–8 mos, 14–16 mos	0, 1, 2, 6, 9, 12, 17 years	Intake, week 32 of pregnancy; 2, 6, 12, 24 months	0
Survey at Ages	A	B at ages 0–4 due to exclusion of non-whites & inclusion of middle class in most estimates; A– thereafter due to small sample size excluding middle class	C– due to spotty documentation, heavy attrition, and loss to follow-up	A	B+ since its eligibility criteria yielded a focus on a needier group than the US programs and birth data from midwives were incomplete	B– due to sparse outcomes; some pregnancies not at term when data were collected

^a Includes 10 women who declined nurse visitation and 11 who declined control group participation. Numbers in parentheses are counts of unmarried low-income mothers

^b All enrollees were under age 26

^c All enrollees were under age 20

^d Includes Asian and Native American, as well as white

^e Insufficient information was available to classify 16 %. White includes 5 % Turks and Moroccans

(2009, 2011) and Matone et al. (2012a, b), for example, used propensity scoring to select a comparison group but lacked the information needed to exclude families who declined NFP services. Decliners probably were at higher risk than those who accepted service. Conversely, lack of data on risk factors used in targeting NFP service offers means the comparison group also may include families at lower risk than NFP families. Thus, the direction of bias is unclear.

We estimated program effectiveness using mixed methods. For binary outcomes (e.g., was a birth preterm or was the child injured), we meta-analytically pooled estimates across the randomized trials, favoring estimates that were regression-adjusted to achieve sample balance. We used systematic review methods for continuous outcomes because some NFP effectiveness estimates came from studies that published mean effect differences but nothing precise about their variance. Also, only one or two effectiveness estimates existed for those outcomes; so, we lacked enough studies to develop cross-study estimates of effect using meta-analytic regressions.

To arrive at effectiveness estimates, we pooled data from randomized trials or computed a mean estimate across them. As described below, we made exceptions for infant mortality as the trials were not powered to detect changes, welfare spending (because eligibility rules changed after the Elmira trial), and immunizations (where replication data favored one trial over another).

Programs typically have lower effectiveness in replication than randomized trial (Lee et al. 2012). Our estimates arbitrarily assume effectiveness declines proportionally with the decline in visits per family from trials to operational programs. That suggests outcomes in replication will be 78.2 % of trial outcomes. We used the Crystal Ball[®] add-in to Excel to run bootstrap simulations that estimated 95 % confidence intervals (CIs) around our estimated savings based on our standard error estimates for percentage gains, 10 % standard errors for the unit medical costs, and a triangular distribution matching interstate visit rate variation for the replication factor.

Our outcome estimates often include problem incidence absent intervention. Additional baseline levels used to compute NFP savings were as follows: (1) percentage of unmarried pregnant women who report smoking during third trimester (20.6 % nationally, from online analysis of 2010 National Survey on Drug Use and Health data), (2) national repeat teen birth rate (Ikramullah et al. 2011), (3) 22 % of first-time low-income births involving pregnancy-induced hypertension (PIH) from New York City Medicaid data prior to NFP implementation (Senter et al. 2010), consistent with the 18 % rate in the pooled Memphis and Elmira control groups, (4) national neonatal mortality rate of 0.419 % (Martin et al. 2011); a rate for low-income infants in Illinois of 1.33 times the average (8.1/6.1) (University of Illinois at Chicago 2010), (5) national child maltreatment rates for low-income families, by year of age, and by type (e.g., physical abuse) (Sedlak et al. 2010), (6)

17.4 % of children aged 0–2 annually treated for injury nationally (Corso et al. 2006), (7) national youth arrest rates by year of age in 2009 (Snyder 2011) with an estimated 5.3 % of youth crimes resulting in arrest (Miller and Hendrie 2015), (8) alcohol, tobacco, and marijuana usage patterns at ages 12–15 from online analysis of 2010 National Survey on Drug Use and Health data.

Results

Table 2 summarizes evidence-based outcomes, our best estimates of effectiveness, and projected cumulative outcomes by 2031 for NFP clients enrolled in 1996–2013. Tables 3 and 4 provide evidence supporting the estimates. Here, we describe the rationale for our choices. All effects are statistically significant at the 95 % confidence level or greater unless otherwise stated.

Reduced Smoking During Pregnancy NFP mothers smoke 24.2 % less tobacco during their pregnancy. Rationale for percentage chosen: Cotinine is the gold-standard measure of tobacco use. Therefore, we chose the Denver trial's value (times 78.2 % expected in replication) over the self-reported estimates. The PA study and NFP data system captured number of smokers rather than quantity smoked. Their information came from birth certificates or other self-reports which are an unreliable source of data on smoking during pregnancy (Northam and Knapp 2006).

Reduced Pregnancy-Induced Hypertension (PIH) PIH declined by 31.3 %. Rationale: We multiplied a pooled 40 % PIH reduction in Elmira and Memphis times the 78.2 % replication factor.

Fewer Preterm First Births NFP reduces preterm births (less than 37 weeks) by 14.7 %. Rationale: Because we want to estimate the impact of NFP in the USA, we used the 18.8 % pooled decrease across 5 US randomized trials times the 78.2 % replication factor. We suspect that this estimate is a conservative lower bound, both because prenatal visits per family have not declined from trials to replication and because the 30 % reductions observed in three analyses of operational programs suggest that 14.7 % may be low.

Fewer Infant Deaths NFP participation reduces infant deaths by 45.4 %. *Rationale:* We chose the 58 % (95 % CI 44–70 %) mortality reduction from Cox's OK study over the Cincinnati rate because results were not commingled with another program. We conservatively defined it as mortality reduction before age 1 and chose it over the sustained 60.7 % reduction in Memphis through age 9. Although the evidence came from operational programs, comparison group

Table 2 Expected life status and financial outcomes when first-time low-income mothers receive Nurse-Family Partnership home visitation services and projected total outcome change due to 177,517 NFP enrollments in 1996–2013

Outcome	Change [95 % CI]	Total [95 % CI]
Smoking During Pregnancy	24 % [5 % CI 2 %, 47 %] reduction in tobacco smoked	8865 [558, 17, 172]
Pregnancy Complications	31 % [16 %, 47 %] reduction in pregnancy-induced hypertension	12,216 [6211, 18,221]
Preterm First Births	15 % [–2 %, 32 %] reduction in births below 37 weeks gestation (25 fewer preterm births per 1000 families served)	3,732 [–545, 8009]
Infant Deaths	45 % [31 %, 63 %] reduction in risk of infant death (2.8 fewer deaths per 1000 families served)	505 [323, 688]
Closely Spaced Second Births	31 % [17 %, 45 %] reduction in births within 2 years postpartum (73 [40, 107] fewer children per 1000 families served within 2 years & lifetime)	12,989 [7069, 18,909]
Subsequent Abortions	31 % [3 %, 38 %] reduction in therapeutic abortions through 4 years post-partum	4724 [964, 8484]
Subsequent Preterm Births	35 [19, 51] fewer subsequent preterm births per 1000 families served	6284 [3437, 9131]
Breastfeeding	11 % [4 %, 19 %] increase in mothers who breastfeed	13,465 [4250, 22680]
Intimate Partner Violence	16 % [8 %, 24 %] reduction intimate partner violence through age 4	36,418 [18,694, 54,141]
Childhood Injuries	33 % [22 %, 43 %] reduction in injuries treated in emergency departments, ages 0–2	15,732 [10,452, 21,012]
Child Maltreatment	31 % [17 %, 45 %] reduction in child maltreatment, ages 4–15	42,450 [22,696, 62,204]
Language Development	39 % [9 %, 69 %] reduction in language delay; 0.14 [.03, .25] fewer remedial services by age 6	28,180 [15,067, 41,294]
Youth Violent Crimes	45 % [30 %, 60 %] reduction in violent crimes, ages 11–19	89,612 [59,354, 119,870]
Youth Property & Public Order Crimes	45 % [30 %, 60 %] reduction in non-violent crimes, ages 11–19	593,611 [393,177, 794,045]
Youth Arrests	45 % [30 %, 60 %] reduction in arrests, ages 11–19	36,103 [23,913, 48,293]
Youth Substance Abuse	53 % [26 %, 81 %] reduction in alcohol, tobacco, and marijuana use, ages 12–15	41,296 [19,957, 62,635]
Immunizations	13 % [–3 %, 29 %] increase in full immunization at age 2	16,154 [7,807, 24,501]
TANF Payments	6 % [–2 %, 13 %] reduction through year 12 post-partum; no effect thereafter	\$247 M [–92 M, 586 M]
Food Stamp Payments	10 % [3 %, 16 %] reduction through at least year 12 post-partum	\$540 M [165 M, 916 M]
Person-months of Medicaid Coverage Needed	8 % [2 %, 13 %] reduction through year 18 post-partum due to reduced births and increased program graduation	4.8 M [3.5 M, 6.1 M]
Costs if on Medicaid	8.5 % [4.5 %, 12.5 %] reduction through age 18	\$1433 M [880 M, 1986 M]
Total Medicaid Spending	Sum of monetized person-months of coverage needed plus costs if on Medicaid	\$2226 M [1445 M, 3007 M]
Subsidized Child Care	Caseload reduced by 3.6 children [1.9, 5.2] per 1000 families served	630 [343, 917]

M=millions. Costs are in 2010 dollars

biases (see the [online supplement](#)) led us to reduce effectiveness with the 78.2 % replication factor.

Improved Birth Spacing NFP mothers have 31.2 % fewer closely spaced second births within 24 months, thus reducing risks of costly complications. In years 3–12 post-partum, NFP neither raises nor lowers the birth rate. *Rationale:* The pooled 39.9 % estimate of reduction in close spacing from the three randomized trials is of highest quality. Applying the 78.2 % replication factor yields a 31.3 % reduction in closely spaced births in replication, close to the 27 % decline for young mothers in PA and the 31 % decline in New York City. Multiplying the percentage reduction times the US 2008 repeat teen birth rate of 23.46 % (Ikramullah et al. 2011) (a more conservative choice than the 28.0 % rate among controls in the pooled trials) suggests NFP mothers choose to bear an average of .0735 fewer subsequent children than controls (or .094

before the replication adjustment, a number used in the [online supplement](#)).

Fewer Abortions within 48 Months of the First Birth 30.7 % reduction in abortions through child age 3. *Rationale:* We multiplied the 39.2 % reduction in pooled Elmira low income, Memphis, and Denver data times the 78.2 % replication factor.

Fewer Subsequent Preterm Births NFP mothers have 0.035 fewer subsequent preterm births. *Computations:* The [online supplement](#) describes the calculations. They account for the preterm birth rate for any subsequent birth and the rate elevation for closely spaced births.

Increased Breast-feeding Attempts 11.2 % (7.6 percentage point) increase in mothers who tried breast-feeding. *Rationale:*

Table 3 Estimates by randomized trial and pooled estimates for 10 dichotomous NFP program outcomes

DOMAIN	Community, Details of Measure, First Author (Year)	Control Cases	Yes (% or mean)	Treatment Cases	Yes (% or mean)	Relative Risk Decline	95 % CI
Pre-eclampsia							
	Elmira, whites only, Olds et al. (1986)	142	7.0 %	166	4.0 %	42.9 %	[-48.7 %, 78.0 %]
	Memphis, Kitzman et al. (1997)	671	20.0 %	455	13.0 %	35.0 %	[13.8 %, 51.0 %]
	Pooled ($p < .001$)	813	17.7 %	621	10.6 %	40.0 %	[21.2 %, 54.3 %]
Preterm First Birth							
	Denver, Olds et al. (2002)	237	10.1 %	222	10.4 %	-2.3 %	[-75.9 %, 40.5 %]
	Elmira, includes nonwhites, M. Knudtson, personal communication (2013)	160	7.5 %	192	7.3 %	2.8 %	[-104.2 %, 53.7 %]
	Louisiana, Sommer (2007)	88	12.5 %	151	6.0 %	52.3 %	[-10.5 %, 79.4 %]
	Memphis, Kitzman et al. (1997)	633	12.0 %	426	10.3 %	14.0 %	[-22.1 %, 39.4 %]
	Orange County, Nguyen et al. (2003)	85	8.2 %	69	4.3 %	47.2 %	[21.0 %, 94.0 %]
	Best Estimate: 5 pooled US trials ($p = .053$)	1203	10.8 %	1,060	8.8 %	18.8 %	[-4.6 %, 37.0 %]
	Netherlands, Mejdoubi et al. (2013)	143	7.0 %	186	8.6 %	-23.0 %	[-162.9 %, 42.4 %]
	All NFP 2005–07 vs. US age-matched, NFP NSO (2014); National Center for Health Statistics (n.d.)	8598	0.7 %	55,737	0.9 %	27.1 %	[4.7 %, 44.3 %]
	Oklahoma single birth very preterm <30 weeks, NFP vs. other first time, Carabin et al. (2005) ^y	-	-	>220	-	37.45 %	-
	Central Ohio, Allen et al. (2010) vs. undescribed local comparison group	-	-	-	-	-	-
Mortality							
	Memphis thru age 9, Olds et al. (2007) ($p = .08$)	489	2.04 %	217	0.46 %	77.5 %	[-74.9 %, 97.1 %]
	Memphis thru age 20, preventable-cause deaths, Olds et al. (2014b) ($p = .04$)	489	1.84 %	217	0 %	100.0 %	Cannot compute
	Denver infant, Olds et al. (2004b)	237	0.84 %	222	0.45 %	46.6 %	[-484.6 %, 95.1 %]
	Oklahoma, before age 1, NFP vs. other first time, Carabin et al. (2005) ^y	55,737	0.55 %	8598	0.29 %	47.6 %	[21.2 %, 65.1 %]
	Oklahoma, unmarried, before age 1, NFP vs. other first time, Carabin et al. (2005) ^b	22,556	-	5239	-	64 %	[37 %, 83 %]
	Oklahoma, mix of endpoints, ages between 1 and 5, NFP vs. other first time, Cox (2006) ^z	-	0.82 %	12,474	0.34 %	58.7 %	[44 %, 70 %]
	Cincinnati, infant, NFP or a 2nd program vs. other local, Donovan et al. (2007)	2145	2.10 %	715	0.70 %	66.7 %	[16.5 %, 86.7 %]
Breastfeeding Attempted							
	Elmira, attempt, whites only, Olds et al. (1983)	121	31.0 %	68	36.0 %	16.2 %	[-23.1 %, 75.8 %]
	Memphis, at 6 months, Kitzman et al. (1997)	471	15.7 %	211	26.1 %	65.9 %	[21.8 %, 125.9 %]
	Pooled ($p = .001$)	592	18.8 %	279	28.5 %	51.3 %	[17.8 %, 94.3 %]
	Netherlands attempt, Mejdoubi et al. (2014)	109	78.0 %	158	82.3 %	5.5 %	[-6.7 %, 19.4 %]
	Netherlands at 6 months, Mejdoubi et al. (2014)	108	5.6 %	156	13.5 %	142.3 %	[1.1 %, 480.4 %]
	NYC, attempt vs. first-time Medicaid, NYC Dept of Health & Mental Hygiene (2013)	-	86 %	V	91 %	5.8 %	-
	NYC, exclusive at 2 months, NYC Dept of Health & Mental Hygiene (2013)	-	30 %	-	40 %	33.3 %	-

Table 3 (continued)

		1,400,000	67.1%	13,490	79.1%	17.9%	-
All NFP in 2009, attempt, NFP NSO (2014) vs. all WIC-eligible, Johnson et al. (2013)							
Child Injury at Ages 0-2							
Elmira, 0–24 months, whites only, Olds et al. (1986)	121	40.0%	75	27.0%	32.5%	[-3.9%, 56.2%]	
Memphis, 0–24 months, unpublished 2006 reanalysis with improved statistical methods, D Olds, personal communication (2011)	467	56.0%	208	42.0%	39.1%	[27.8%, 48.7%]	
Louisiana, 0–15 months, Sommer (2007)	116	69.0%	66	34.5%	50.0%	[28.8%, 64.9%]	
Pooled ($p < .001$)	704	64.0%	349	37.4%	41.6%	[32.4%, 49.6%]	
Pennsylvania, 0–24months, ED-treated, Matone et al. (2012b)	16,704	36.4%	5016	41.5%	-14.0%	[-9.7%, -18.5%]	
Child Maltreatment							
Elmira, ages 4–15years, Eckenrode et al. (2000)	184	73%	116	44%	39.7%	[22.8%, 53.0%]	
Netherlands, 0–36months, Mejdoubi et al. (2015)	164	18.9%	168	10.7%	43.3%	[2.8%, 67.0%]	
Second Birth Within 24Months							
Elmira low-income whites, Olds et al. (1988)	52	39.0%	25	10.8%	72.2%	[10.0%, 91.4%]	
Memphis, Kitzman et al. (1997)	467	31.0%	208	22.0%	29.0%	[5.2%, 46.9%]	
Denver, Olds et al. (2002)	223	19.0%	194	12.0%	36.8%	[-0.01%, 60.4%]	
Pooled ($p < .001$)	742	28.0%	427	16.8%	39.9%	[23.5%, 52.7%]	
Pennsylvania, 2000–2003, Rubin et al. (2011)	-	18.9%	-	19.3%	-9%	[-26%, 5%]	
Pennsylvania, 2004–2005, Rubin et al. (2011)	-	19.0%	-	16.8%	13%	[4%, 20%]	
Abortion Within 48 Months							
Elmira low-income whites, Olds et al. (1988)	54	12.0%	28	10.0%	16.7%	[-213.6%, 77.9%]	
Memphis, Kitzman et al. (2000)	443	10.0%	203	5.0%	50.0%	[3.1%, 74.2%]	
Denver, Olds et al. (2004b)	220	5.2%	204	4.9%	5.7%	[-115.5%, 58.8%]	
Pooled ($p = .034$)	717	8.7%	435	5.3%	39.2%	[3.3%, 61.8%]	
Intimate Partner Violence Through Age 4							
a. Denver, ages 0–6 months, M. Knudtson, personal communication (2014)	220	12.7%	184	10.3%	18.9%	[-40.4%, 53.1%]	
b. Denver, ages 6–12 months, same source as a	219	9.6%	187	10.2%	-6.0%	[-91.0%, 41.2%]	
c. Denver, ages 15–21 months, same source as a	225	9.3%	202	8.9%	4.5%	[-74.0%, 47.6%]	
d. Denver, age 4, Olds et al. (2004b)	220	10.0%	204	4.9%	51.0%	[-0.1%, 76.2%]	
e. Denver pooled ages 0–4	884	10.4%	777	8.5%	18.4%	[-10.3%, 39.6%]	
f. Memphis, ages 0–5, Olds et al. (2004a), recall-adjusted 6months	444	18.2%	197	17.8%	1.8%	[-21.1%, 20.4%]	
g. Louisiana, ages 0–1, Nagle (2002)	63	28.6%	56	19.6%	31.3%	[-32.8%, 64.4%]	
Best US estimate per 6months, ages 0–4; pool e, f, g ($p = .036$)	1391	13.7%	1030	10.9%	20.6%	[1.1%, 36.1%]	
Netherlands, ages 1–2, Mejdoubi et al. (2013), recall-adjusted 6months	223	37.7%	237	22.4%	40.5%	[22.8%, 54.1%]	
All NFP, intake vs. 36weeks, NFPNSO (2014)	83,313	2.9%	83,313	1.8%	37.9%	[33.9%, 41.8%]	
Youth Arrests, Lifetime							
Elmira, ages 11–19, Eckenrode et al. (2010)	140	0.86	91	0.37	57.0%	[20%, 77%]	

NS=not significant, -=not reported

^a The control group had higher income and marriage rates. The article lacked data needed to combine its regression adjusted estimates. Looking across four subgroups, it seemed unlikely that preterm births declined.

^b Comparison group estimate regression-adjusted for equivalency

Table 4 Evidence about six outcomes of NFP by study

Domain community, measure	Study	Comparison	NFP	% change	Notes
Smoking During Pregnancy					
Elmira self-report, cigarettes/smoker	Olds et al. (1986)	11.3 %	-16.0 %	-27.4 %	$p < .01$
Memphis, self-report, cigarettes/smoker	D. Luckey, personal communication (2012)	-	-	decline	NS
Denver, smoker cotinine level	Olds et al. 2002	-12.32	-259.00	-31.3 %	$p < .05$
Netherlands, self-report, # cigarettes	Mejdoubi et al. (2014)	61.7 %	73.4 %	-19.0 %	$p = .03 ?$
Pennsylvania, operational start-up, birth certificate, # smokers	Matone et al. (2012a)	25.8 %	28.4 %	-10.1 %	$p = .11$
Pennsylvania, mature operational program, birth certificate, # smokers	Matone et al. (2012a)	27.5 %	35.4 %	-28.7 %	$p < .01$
All NFP, intake vs. 36 weeks, # self-reported smokers	NFP National Services Office (NSO) (2014)	12.6 %	10.6 %	-15.9 %	weak evidence
Language Development					
Elmira, language development, measured at ages 3 and 4, white low income teens	Olds et al. (1994)			11 %, 20 %	$p < .01$
Memphis, storytelling skills, and receptive vocabulary, age 6	Olds et al. (2004a)			3 %, 5 %	$p < .05$
Denver, language delay at ages 2 and 4; confirmed by Memphis measures at age 6	Olds et al. (2002, 2004b, 2014a)			-50 %	$p < .05$
Youth Substance Abuse					
Elmira, 6-month use alcohol, tobacco, and other drugs (ATOD), ages 12–15	Olds et al. (1998), reanalyzed	-	-	-67 %	$p < .05$
Elmira, 6-month use alcohol, age 19	Eckenrode et al. (2010)	31.8 %	28.4 %	-10.7 %	$p = .60$
Elmira, 6-month use illicit drugs, age 19	Eckenrode et al. (2010)	51.9 %	48.7 %	-6.2 %	$p = .57$
Memphis, 30-day use ATOD, age 12	Kitzman et al. (2010)	5.1 %	1.7 %	-69 %	$p = .04$
Full Immunization					
Elmira, complete at age 2, whites only	Olds et al. (1983)	66.8 %	78.4 %	17.4 %	$p = .14$
Memphis, age 2, control received reminder and transport	Kitzman et al. (1997)	68 %	70 %	2.9 %	$p = .60$
NYC, age 2, NFP vs. all births	NYC Dept. of Health and Mental Hygiene (2013)	77 %	94 %	22.1 %	-
Nationally, age 2, NFP nurse-assessed vs. Medicaid HMO client HMO-assessed	NFP NSO (2014), National Committee for Quality Assurance (2011)	70 %	92 %	31.4 %	-
TANF Payments Per Year					
Elmira, ages 0–15	Glazner et al. (2004)	4358	2866	-34.2 %	$p = .05$
Memphis, ages 0–12	Olds et al. (2010)	2782	2467	-11.3 %	$p = .14^a$
Denver, ages 0–4	Glazner et al. (2004)	3304	3204	-3.0 %	$p = .64$
FOOD STAMPS					
Elmira, ages 0–15	Glazner et al. (2004)	2119	1476	-30.3 %	$p = .03$
Memphis, ages 0–12	Olds et al. (2010)	3222	2870	-10.9 %	$p < .01$
Denver, ages 0–4	Glazner et al. (2004)	2684	2.383	-11.2 %	$p = .22$
Months per Year Income-Eligible for Medicaid					
Elmira, ages 0–15	Olds et al. (1997)	4.67	4.10	-13.0 %	$p = .16$
Memphis, ages 0–12	Olds et al. (2010)	8.39	8.08	-3.7 %	$p = .22^b$
Denver, ages 0–6	D. Luckey, personal communication (2012)	4.15	3.91	-5.8 %	$p = .48$

NS=Not significant, -=Not reported

^aMonths on TANF differ at $p = .05$

^bMedicaid HMO payments differ at $p < .01$

In pooled Elmira and Memphis data, breast-feeding rose 9.7 percentage points. Multiplying times 78.2 % yields an estimated 7.6 percentage point increase (an 11.3 % increase over the

2011 WIC-eligible breast-feeding level). This estimate should be conservative as it is lower than the observed 10.0–11.6 percentage point increase in operational programs.

Reduced Intimate Partner Violence (IPV) 16.1 % reduction in IPV through child age 4. Rationale: Violent victimization is subject to recall bias (Bushery 1981). Therefore, we favored 6 months over 3-year recall in Denver. As the [online supplement](#) details, we adjusted recall beyond 6 months for recall bias and computed 6-month victimization rates from longer-term reports. Pooling US data from like time periods (including using the presumably understated 2 % estimate from Memphis at ages 0–5 multiple times), average reductions were 31.7 % prenatally, 19.5 % at ages 0–2, and 26.9 % at age 4. Reductions of 12.5–15.1 % at ages 6 and 9 were not significant at even the 80 % confidence level; so, we assumed reductions ended at age 4. From ages 0–4, IPV was reduced by 20.6 %, which we multiplied times the 78.2 % replication factor. We defined IPV rates per 6-month period absent NFP as the 13.7 % postnatal probability and 18.1 % prenatal probability in the pooled control groups from the three US trials.

Fewer Childhood Injuries Through age 2, NFP babies have 32.6 % fewer injuries treated in emergency departments (EDs) or admitted to hospital. Rationale: Multiplying the pooled 41.6 % reduction across the Elmira, Louisiana, and Memphis trials times 78.2 % suggests a 32.6 % reduction in replication.

Fewer Child Maltreatments NFP reduces child maltreatment by 31.0 % at ages 4 through 15. Rationale: We multiplied the 39.7 % US reduction from Elmira (which is slightly lower than the Dutch reduction) times the 78.2 % replication factor. Child maltreatment follows a severity distribution; so, we assume that unconfirmed case counts will change as CPS-confirmed (substantiated or otherwise indicated) counts do. That assumption is conservative because NFP increases detection and captures evidence required for substantiation (Olds et al. 1995), which should cause a larger decrease in unconfirmed than confirmed cases. Temporally, reductions are concentrated at ages 4–15 (Zielinski et al. 2009). Our analysis conservatively assumes any effect before that age is subsumed in the broader reduction in nonfatal injury through age 2.

Better Language Development NFP reduces language delay by 39.1 %, thus reducing the need for preschool or school-based remedial services. Rationale: Although the Elmira and Memphis trials demonstrated language development gains, Denver measured them more clearly. We multiplied the 50 % reduction in Denver times the 78.2 % replication factor.

Fewer Youth Criminal Offenses NFP reduces youth arrests by 44.6 % at ages 11 through 19, with reduced arrests of girls predominating and arrest probabilities equalizing by age 19. Rationale: To date, this outcome only was reported in Elmira. We multiplied Elmira's 57 % reduction times the 78.2 %

replication factor. We assumed reduction in crimes committed mirrored reduction in arrests.

Reduced Youth Substance Abuse NFP reduces alcohol, tobacco, and marijuana use by 53.2 % at age 12 until at least age 15. Rationale: We multiplied the 68 % average reduction in Elmira and Memphis times the 78.2 % replication factor.

Increased Immunizations NFP participation is associated with a 13.0 % (9.1 percentage point) increase in probability that children covered by Medicaid will have complete immunizations at age 2. Rationale: We multiplied the 11.6 percentage point reduction versus Elmira controls without transport assistance times the 78.2 % replication factor. The Memphis trial estimate on this measure is contaminated because the trial reminded controls about and transported them to immunizations. Although 2 operational program comparisons found statistically significant 19 and 22 percentage point differences ($p > .95$), neither was based on a carefully matched sample.

Reduced TANF Payments NFP reduces Temporary Assistance for Needy Families (TANF) payments by 5.6 % for 12 years post-partum. These savings result from reduced subsequent births and altered earning patterns that reduce TANF eligibility and payments per eligible family. Rationale: We multiplied the 7.2 % average reduction for the TANF-specific Memphis and Denver evaluations times the 78.2 % replication factor. Applying this percentage to current TANF participation data accounts for the downward shift in participation since 1996.

Reduced Food Stamp Payments NFP reduces food stamp payments by 9.6 % for at least 12 years post-partum. These savings result from reduced subsequent births and altered earning patterns that reduce food stamp eligibility and payments per eligible family. Rationale: We multiplied the 12.3 % average reduction across the three trials times the 78.2 % replication factor.

Reduced Need for Medicaid Coverage NFP reduces person-months on Medicaid by 7.6 % for at least 15 years post-partum, with these savings expected to continue. The participation reductions have two causes. First, the reduced second birth rate resulting from NFP services and possibly differences in earning patterns increase Medicaid graduation of mothers and to a lesser extent, of first-born children (although fewer children would graduate today because the Child Health Insurance Program and Affordable Care Act raised many state income eligibility thresholds). Second, NFP mothers bear fewer children. The births avoided are closely spaced ones at high risk of costly complications. Associated Medicaid cost savings include both birth-related costs and costs of continuing Medicaid participation of these second

babies. Rationale: We multiplied the 9.8 % average reduction across the three trials times the 78.2 % replication factor.

Lower Costs if on Medicaid NFP reduces the present value of Medicaid spending per child recipient by 8.5 % from birth through age 18 (bootstrap-estimated 95 % CI 4.5 %, 12.5 %). As documented above, NFP reduces smoking during pregnancy and related prematurity, pregnancy-associated preeclampsia, child injury in the first two years of life, medical and mental health spending on victims of child maltreatment, adherence to immunization schedules, and second births with complications. Those health status improvements should reduce Medicaid claims costs of mothers and first-born children. Rationale: Data availability prevented direct evaluation of savings in the randomized trials. The [online supplement](#) models the savings. We divided the savings by the present value of annual Medicaid spending per child recipient from birth through age 18 exclusive of live birth costs, \$35,287 (Henry J Kaiser Family Foundation 2014).

Reduced Subsidized Child Care, Second Births An estimated 4.85 % of the second babies who would have been born within two years of the first birth would have used subsidized child care funded by the Child Care Development Block Grant. Computations: 4.85 % of Medicaid and SCHIP children use subsidized child care nationwide (Office of Child Care 2010). We multiplied that rate times the 7.35 % reduction in subsequent births (derived above).

Other Outcomes As the on-line supplement details, low birth weight, subsequent miscarriages, intimate partner violence after age 4, maternal criminal offenses, maternal depression, and grade retention declined in some trials but not in others or changed consistently but not enough to differ statistically from controls at the 90 % confidence level.

Outcomes Achieved The last column in Table 2 shows estimated problems that program enrollments in 1996–2013 prevented or are projected to prevent and 95 % confidence intervals for those estimates. NFP enrollments through 2013 will prevent a projected 500 infant deaths, 10,000 preterm births, 4700 abortions, 13,000 dangerous closely spaced second births, 42,000 child maltreatment incidents, 16,000 other child injuries, 36,000 intimate partner violence incidents, 90,000 violent crimes by youth, 594,000 property and public order crimes (e.g., vandalism, loitering) by youth, 36,000 youth arrests, and 41,000 person-years of youth substance abuse. It will cause 16,000 children to comply with immunization schedules.

Since NFP families earn more and space children better, they place fewer burdens on government safety net programs. NFP is expected to eliminate the need for 4.8 million person-months of child Medicaid coverage. In 2010 dollars,

(converted to present value using a 3 % discount rate), it will reduce estimated spending on TANF by \$250 million, on food stamps by \$540 million, and on Medicaid by \$2.2 billion. Safety net savings will total \$3.0 billion.

Discussion

NFP has broad-reaching effects on lives of mothers and children. Longitudinal NFP trials, therefore, can assess hundreds of outcomes. Statistically, a 95 % confidence level means 95 of 100 significant differences are real and five are artifacts, random events that do not represent true differentials. Given that, this systematic review fills a critical need by identifying findings that are consistent across trials or are significant at the 99 % confidence interval, meaning they should remain significant after statistical adjustment to account for the large number of outcomes tested.

Ethnic diversity of the trial populations is both a strength and a weakness. Reassuringly, trial findings replicate across cultures. Differential effectiveness, however, could represent cultural differences rather than lack of replicability. Olds et al. (1986) reported Elmira results for white mothers only while Orange County was restricted to teenaged Hispanic mothers. By design, these trials essentially become subgroup analyses. If outcomes vary by race/ethnicity, our practice of computing pooled cross-trial impacts giving each family equal weight may not yield a valid picture for the USA as a whole. At the same time, stratifying by race would virtually exclude Asians and Native Americans and force reliance on subgroup analyses for blacks. Smaller samples in subgroup analyses tend to lack statistical power and have wide uncertainty.

Our analysis has additional limitations. Some outcomes only were evaluated in one trial. Even pooling across six trials, impacts on birth outcomes are clouded by modest statistical power. (Ongoing trials should elucidate these effects.) Recent changes in safety net program rules, smoking rate, and teen birth rate reduce our confidence that related trial outcomes are replicable. Impact estimates also are less certain for outcomes like child maltreatment and medically treated injuries where nurse presence can increase reporting or change treatment decisions. Estimated Medicaid savings largely are computed, not observed. Although effectiveness is likely to decline from trials to operational programs, the degree of decline is unclear so our adjustment unavoidably is somewhat arbitrary. Finally, our national estimates implicitly assume operational program and trial populations are similar. Indeed, the birth-proximal outcomes generally replicate or are exceeded in the trials not conducted by the developers, the national data system, and many of the methodologically weaker evaluations of program efficacy in operational programs.

NFP clearly achieved most of its goals. It enriched the lives of participating low-income mothers and their offspring. It

will benefit society more broadly by reducing crime and safety net demand. The \$3.0 billion in expected TANF, food stamp, and Medicaid spending reductions (95 % CI, \$2.0–\$4.1 billion) far exceed the program's \$1.6 billion cost.

Federal policy has embraced home visiting programs. Our findings affirm that home visiting using the NFP program model makes major differences in the lives of low income families. It reduces intimate partner violence, child maltreatment, and youth crime and substance abuse, increases independence, and saves both money and lives. Expanding MIEC HV and other public funding for NFP thus seems a wise investment. Nevertheless, the high cost per family requires a substantial front-end investment.

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References

- Allen, S., Blum, D. P., Gabbe, S. G., Von Zychin, C., Brooks, P., Brown, M., O'Grady, J., & Long, T. (2010). *Better beginnings: 2009 annual report*. Columbus: Better Birth Outcomes.
- Bushery, J. (1981). Recall bias for different reference periods in the National Crime Survey. 1981 Proceedings of the Section on Survey Research Methods, American Statistical Association, 238–243.
- Carabin, H., Cowan, L. D., Beebe, L. A., Skaggs, V. J., Thompson, D., & Agbangla, C. (2005). Does participation in a nurse visitation programme reduce the frequency of adverse perinatal outcomes in first-time mothers? *Paediatric Perinatal Epidemiology*, *19*, 194–205.
- Corso, P. C., Finkelstein, E., Miller, T. R., Fiebelkorn, I. A., & Zaloshnja, E. (2006). Incidence and lifetime costs of injuries in the United States. *Injury Prevention*, *12*, 212–218.
- Cox, M. (2006). *An analysis of deaths among infants and children born into the Children First program, 1997–2004*. Oklahoma City: Children First.
- Donovan, E. F., Ammerman, R. T., Besl, J., Atherton, H., Khoury, J. C., Altaye, M., Putnam, F. W., & Van Ginkel, J. B. (2007). Intensive home visiting is associated with decreased risk of infant death. *Pediatrics*, *119*, 1145–1151.
- Eckenrode, J., Ganzel, B., Henderson, C., Smith, E., Olds, D., Powers, J., Cole, R., Kitzman, H., & Sidora, K. (2000). Preventing child abuse and neglect with a program of nurse home visitation: The limiting effects of domestic violence. *Journal American Medical Association*, *284*, 1385–1391.
- 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 Pediatric & Adolescent Medicine*, *164*, 9–15.
- Glazner, J., Bondy, J., Luckey, D., & Olds, D. (2004). Final report to the Administration for Children and Families: Effect of the nurse family partnership on government expenditures for vulnerable first-time mothers and their children in Elmira, New York, Memphis, Tennessee, and Denver, Colorado Washington, DC: Administration for Children and Families, Office of Planning, Research and Evaluation.
- Henry J Kaiser Family Foundation. (2014). Medicaid payments per enrollee, FY 2010. Retrieved July, 2014, from <http://kff.org/medicaid/state-indicator/medicaid-payments-per-enrollee/>.
- Ikramullah, E., Barry, M., Manlove, J., & Moore, K. A. (2011). *Facts at a glance: A fact sheet reporting national, state, and city trends in teen child-bearing*. Washington, DC: Child Trends.
- 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.
- Johnson, B., Thorn, B., McGill, B., Suchman, A., Mendelson, M., Patlan, K. L., Freeman, B., Gotlieb, R., & Connor, P. (2013). *WIC participant and program characteristics 2012 final report*. Washington DC: Food and Nutrition Service, US Department of Agriculture.
- Karoly, L. A., & Bigelow, J. H. (2005). *The economics of investing in universal preschool education in California*. Santa Monica: RAND Corporation.
- Kitzman, H., Olds, D. L., Henderson, C. R., Jr., Hanks, C., Cole, R., Tatelbaum, R., McConnochie, K. M., Sidora, K., Luckey, D. W., Shaver, D., Engelhardt, K., James, D., & Barnard, K. (1997). Effect of prenatal and infancy home visitation by nurses on pregnancy outcomes, childhood injuries, and repeated childbearing: A randomized controlled trial. *Journal of the American Medical Association*, *278*, 644–652.
- Kitzman, H., Olds, D. L., Sidora, K., Henderson, C. R. J., Hanks, C., Cole, R., Luckey, D. W., Bondy, J., Cole, K., & Glazner, J. (2000). Enduring effects of nurse home visitation on maternal life course: A 3-year follow-up of a randomized trial. *Journal of the American Medical Association*, *283*, 1983–1999.
- Kitzman, H. J., Olds, D. L., Cole, R. E., Hanks, C. A., Anson, E. A., Arcoleo, K. J., Luckey, D. W., Knudtson, M. D., Henderson, C. R., Jr., & Holmberg, J. R. (2010). Enduring effects of prenatal and infancy home visiting by nurses on children: Follow-up of a randomized trial among children at age 12 years. *Archives of Pediatric and Adolescent Medicine*, *164*, 412–418.
- Lee, S., Aos, S., Drake, E., Pennucci, A., Miller, M., & Anderson, L. (2012). *Return on investment: Evidence-based options to improve statewide outcomes*. Olympia: Washington State Institute for Public Policy.
- Martin, J. A., Hamilton, B. E., Ventura, S. J., Osterman, M. J. K., Kirmeyer, S., Mathews, T. J., & Wilson, E. C. (2011). Births: Final data for 2009. National Vital Statistics System, 60:1. Hyattsville, MD: National Center for Health Statistics.
- Matone, M., O'Reilly, A., Luan, X., Localio, R., & Rubin, D. (2012a). Home visitation program effectiveness and the influence of community behavioral norms: A propensity score matched analysis of prenatal smoking cessation. *BMC Public Health*, *12*, 1016.
- Matone, M., O'Reilly, A., Luan, X., Localio, A., & Rubin, D. (2012b). Emergency department visits and hospitalizations for injuries among infants and children following statewide implementation of a home visitation model. *Maternal and Child Health Journal*, *16*, 1754–1761.
- Mejdoubi, J., van den Heijkant, S. C., van Leerdam, F. J., Heymans, M. W., Hirasung, R. A., & Crijnen, A. A. (2013). Effect of nurse home visits vs. usual care on reducing intimate partner violence in young high-risk pregnant women: A randomized controlled trial. *PLoS ONE*, *8*, e78185.

- Mejdoubi, J., van den Heijkant, S. C., van Leerdam, F. J., Crone, M., Crijnen, A., & Hirasning, R. A. (2014). Effects of nurse home visitation on cigarette smoking, pregnancy outcomes and breastfeeding: A randomized controlled trial. *Midwifery*, *30*, 688–695.
- Mejdoubi, J., van den Heijkant, S. C., van Leerdam, F. J., Heymans, M. W., Crijnen, A. A., & Hirasning, R. A. (2015). The effect of VoorZorg, the Dutch nurse family partnership, on child maltreatment and development: A randomized controlled trial. *PLoS ONE*, *10*, e0120182.
- Miller, T., & Hendrie, D. (2015). *Incidence and costs of violence and other personal crimes, United States, 2010*. Calverton: Pacific Institute for Research & Evaluation.
- Miller, T. R., & Levy, D. T. (2000). Cost-outcome analysis in injury prevention and control: Eighty-four recent estimates for the United States. *Medical Care*, *38*, 562–582.
- Nagle, G. (2002). Maternal participation, depression, and partner violence in a state-run child abuse prevention program: Louisiana nurse home visitation, 1999–2002. Unpublished Doctoral dissertation, Tulane University, New Orleans.
- National Center for Health Statistics. (n.d.). Health data interactive. Retrieved May 11, 2011, from the World Wide Web: <http://www.cdc.gov/nchs/hdi.htm>.
- National Committee for Quality Assurance. (2011). Continuous improvement and the expansion of quality measurement: The state of health care quality 2011. National Committee for Quality Assurance. Retrieved February 28, 2012, from the World Wide Web: <http://www.ncqa.org/LinkClick.aspx?fileticket=FpMqqpADPo8%3D>
- Nguyen, J. D., Carson, M. L., Parris, K. M., & Place, P. (2003). A comparison pilot study of public health field nursing home visitation program interventions for pregnant Hispanic adolescents. *Public Health Nursing*, *20*, 412–418.
- Northam, S., & Knapp, T. R. (2006). The reliability and validity of birth certificates. *Journal of Obstetrics, Gynecology, and Neonatal Nursing*, *35*, 3–12.
- Nurse-Family Partnership National Service Office. (2011). Guidance for implementation and quality of the Nurse-Family Partnership Program. Retrieved from http://www.nursefamilypartnership.org/assets/PDF/Policy/HV-Funding-Guidance/NFP_Guidance_Implementation_Quality.aspx, accessed July 2014.
- Nurse-Family Partnership National Service Office. (2014). *Quarterly report for national NFP: Data through 31 Dec 2013*. Denver: Nurse-Family Partnership National Service Office.
- NYC Department of Health and Mental Hygiene. (August/September 2013). Featured outcomes for NYC NFP moms 2003–2013. *NYC Nurse-Family Partnership E-News*, p. 5.
- Office of Child Care. (2010). FY 2010 final CCDF allocations (Including reallocated funds). Administration for Children and Families, DHHS.
- Olds, D. L., Henderson, C. R., Birmingham, M. T., Chamberlin, R., & Tatelbaum, R. (1983). *Final report: Prenatal/early infancy project*. Springfield: National Technical Information Service.
- Olds, D. L., Henderson, C. R., Tatelbaum, R., & Chamberlin, R. (1986). Improving the delivery of prenatal care and outcomes of pregnancy: A randomized trial of nurse home visitation. *Pediatrics*, *77*, 16–28.
- Olds, D. L., Henderson, C. R., Tatelbaum, R., & Chamberlin, R. (1988). Improving the life-course development of socially disadvantaged mothers: A randomized trial of nurse home visitation. *American Journal of Public Health*, *78*, 1436–1445.
- Olds, D. L., Henderson, C. R., Jr., & Kitzman, H. (1994). Does prenatal and infancy nurse home visitation have enduring effects on qualities of parental caregiving and child health at 25 to 50 months of life? *Pediatrics*, *93*, 89–98.
- Olds, D. L., Henderson, C. R., Jr., Kitzman, H., & Cole, R. (1995). Effects of prenatal and infancy nurse home visitation on surveillance of child maltreatment. *Pediatrics*, *95*, 365–372.
- Olds, D. L., Eckenrode, J., Henderson, C. R., Kitzman, H., Powers, J., Cole, R., Sidora, K., Morris, P., Pettitt, L. M., & Luckey, D. (1997). Long-term effects of home visitation on maternal life course and child abuse and neglect. *Journal of the American Medical Association*, *278*, 637–643.
- Olds, D. L., Henderson, C. R., Jr., Cole, R., Eckenrode, J., Kitzman, H., Luckey, D., Pettitt, L., Sidora, K., Morris, P., & Powers, J. (1998). Long-term effects of nurse home visitation on children's criminal and antisocial behavior: 15-year follow-up of a randomized controlled trial. *Journal of the American Medical Association*, *280*, 1238–1244.
- Olds, D. L., Robinson, J., O'Brien, R., Luckey, D. W., Pettitt, L. M., Henderson, C. R., Ng, R. N., Korfmacher, J., Hiatt, S., & Talmi, A. (2002). Home visiting by paraprofessionals and nurses: A randomized, controlled trial. *Pediatrics*, *110*, 486–496.
- Olds, D. L., Kitzman, H., Cole, R., Robinson, J., Sidora, K., Luckey, D. W., Henderson, C. R., Hanks, C., Bondy, J., & Holmberg, J. (2004a). Effects of nurse home visiting on maternal life course and child development: Age 6 follow-up results of a randomized trial. *Pediatrics*, *114*, 1550–1559.
- Olds, D. L., Robinson, J., Pettitt, L. M., Luckey, D. W., Holmberg, J., Ng, R. K., Isacks, K., Sheff, K., & Henderson, C. R. (2004b). Effects of home visits by paraprofessionals and by nurses: Age 4 follow-up results of a randomized trial. *Pediatrics*, *114*, 1560–1568.
- Olds, D. L., Kitzman, H., Hanks, C., Cole, R., Anson, E., Sidora-Arcoleo, K., Luckey, D. W., Henderson, C. R., Jr., Holmberg, J., Tutt, R. A., Stevenson, A. J., & Bondy, J. (2007). Effects of nurse home visiting on maternal and child functioning: Age-9 follow-up of a randomized trial. *Pediatrics*, *120*, e832–e845.
- Olds, D. L., Kitzman, H. J., Cole, R. E., Hanks, C. A., Arcoleo, K. J., Anson, E. A., Luckey, D. W., Knudtson, M. D., Henderson, C. R., Jr., Bondy, J., & Stevenson, A. J. (2010). Enduring effects of prenatal and infancy home visiting by nurses on maternal life course and government spending: Follow-up of a randomized trial among children at age 12 years. *Archives of Pediatric and Adolescent Medicine*, *164*, 412–418.
- Olds, D. L., Donelan-McCall, N., O'Brien, R., MacMillan, H., Jack, S., Jenkins, T., Dunlap, W. P. I., O'Fallon, M., Yost, E., Thorland, B., Pinto, F., Gasbarro, M., Baca, P., Melnick, A., & Beeber, L. (2013). Improving the nurse-family partnership in community practice. *Pediatrics*, *132*, S110–S117.
- Olds, D. L., Holmberg, J., Donelan-McCall, N., Luckey, D., Knudtson, M., & Robinson, J. (2014a). 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*, 114–121.
- Olds, D. L., Kitzman, H., Knudtson, M., Anson, E., Smith, J., & Cole, R. (2014b). Effect of home visiting by nurses on maternal and child mortality: Results of a 2-decade follow-up of a randomized clinical trial. *JAMA Pediatrics*, *168*, 800–806.
- Rubin, D. M., O'Reilly, A. L. R., Luan, X., Dai, D., Localio, A. R., & Christian, C. W. (2009). *Evaluating the Nurse-Family Partnership programs in the Commonwealth of Pennsylvania. Executive summary*. Philadelphia: The Children's Hospital of Philadelphia Research Institute.
- Rubin, D. M., O'Reilly, A. L. R., Luan, X., Dai, D., Localio, A. R., & Christian, C. W. (2011). Variation in pregnancy outcomes following statewide implementation of a prenatal home visitation program. *Archives of Pediatric & Adolescent Medicine*, *165*, 198–204.
- Sandner, M. (2013a). Effects of early childhood intervention on child development and early skill formation: Evidence from a randomized controlled trial. Discussion paper 518 Retrieved from <http://www.econstor.eu/bitstream/10419/92949/1/768255511.pdf>, accessed July 2014.
- Sandner, M. (2013b). Effects of early childhood intervention on maternal employment, fertility and well-being. Evidence from a randomized experiment. Discussion paper 516. Retrieved from <http://ideas.repec.org/p/han/dpaper/dp-516.html>, accessed July 2014.

- Sedlak, A. J., Mettenburg, J., Basena, M., Petta, I., McPherson, K., Greene, A., & Li, S. (2010). *Fourth national incidence study of child abuse and neglect (NIS-4): Report to Congress*. Washington, DC: Administration for Children and Families.
- Senter, L., Pai, N., & Miller, T. (2010). *Benefits and costs of nurse-family partnership in New York City over 15 years, city government perspective*. New York City: Department of Health and Mental Hygiene.
- Snyder, H. N. (2011). Arrests in the US 1980–2009. NCJ 234319. Washington, DC: Bureau of Justice Statistics.
- Sonnier, S. W. (2007). *Nurse-Family Partnership - Demonstrating results, Prepared for Baptist Community Ministries*. New Orleans: Tulane University of Infant and Early Childhood Mental Health.
- University of Illinois at Chicago. (2010). Maternal and child health services block grant FFY'11 needs assessment. Springfield, IL: Illinois Department of Human Services, Division of Specialized Care for Children.
- 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, 441–453.