



## **LIFE STATUS AND FINANCIAL OUTCOMES OF NURSE-FAMILY PARTNERSHIP IN CALIFORNIA**

The Nurse-Family Partnership (NFP) uses a series of prenatal and postnatal home visits by registered nurses to increase the parenting and life skills of low-income mothers bearing their first child. The outcomes of NFP on the lives of mothers and children have been evaluated in randomized controlled trials in Denver, Elmira, Memphis, Orange County, CA, Louisiana, and the Netherlands, and with weaker evaluation designs in large-scale replication in New York City, Ohio, Oklahoma, and Pennsylvania.<sup>1</sup> This fact sheet describes the statistically significant life status and financial changes documented in the evaluations. The range of life status and financial measures evaluated was much broader in Denver, Elmira, and Memphis than elsewhere. Those three sites also have tracked outcomes longitudinally.

We relied on a published systematic review of more than 30 NFP evaluations (Miller, 2015). Based on statistically significant life status and financial changes it documented, this fact sheet estimates NFP outcomes as implemented in California.

Evaluations reveal 19 life status and financial outcomes of NFP. Table 1 summarizes these outcomes. They affect health behaviors, health status, education, criminal offending, and reliance on the public safety net. The text describes the size of each outcome and evidence supporting it.

We conservatively assume effectiveness declines in proportion to the decline in visits per family from randomized trials to wide-scale replication. Therefore we multiply effectiveness in trials times a replication effectiveness reduction factor of 78.9%.

As Table 2 shows, in California, enrolling 1000 low-income families in NFP will prevent 47 preterm births, 107 closely-spaced, high-risk second pregnancies, 232 person-years of intimate partner violence, 207 child maltreatment incidents, 99 violent crimes and 652 property and public order crimes (e.g., vandalism, loitering) by youth, 40 youth arrests, 208 person-years of youth substance abuse, and 2.9 infant deaths. These estimates, although robust, are based on conservative assumptions. A person-year means a year when someone avoided one or more harmful incidents.

### **METHODS**

This section presents evidence supporting each estimate in Table 1 and describes the rationale for our choices. All effects listed are statistically significant at the 95% confidence limit or greater unless otherwise stated.

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<sup>1</sup> Louisiana trial data are less reliable than data from other trials because of heavy early dropout and loss to follow-up. Its documentation is incomplete, simply a list of significant findings. The Orange County trial had too few adverse birth outcomes to support sound statistical testing of significance of observed differences. Its birth-outcome evaluation was conducted early, before some pregnancies reached term.

**Table 1. Expected Life Status and Financial Outcomes When First-Time Low-Income Mothers Receive Nurse-Family Partnership Home Visitation Services in California**

<b>Outcome</b>	<b>Change</b>
Smoking During Pregnancy	24% reduction in tobacco smoked
Complications of Pregnancy	32% reduction in pregnancy-induced hypertension
Preterm First Births	15% reduction in births below 37 weeks gestation (19 fewer preterm births per 1,000 families served)
Infant Deaths	46% reduction in risk of infant death (2.9 fewer deaths per 1,000 families served)
Closely Spaced, High-Risk Pregnancies	36% reduction in closely spaced, high-risk pregnancies within 15 months postpartum during 4 years after the first birth
Very Closely Spaced Births	24% reduction in second births within 15 months postpartum
Subsequent Preterm Births	27.3 fewer subsequent preterm births per 1,000 families served
Breastfeeding	11% increase in mothers who attempt to breastfeed
Intimate Partner Violence	16% reduction in assaults, prenatal to child age 5
Child Maltreatment	31% reduction in child maltreatment through age 15
Childhood Injuries	33% reduction in injuries treated in emergency departments, ages 0-2
Language Development	39% reduction in language delay; 0.14 fewer remedial services by age 6
Youth Criminal Offenses	24% reduction in crimes and arrests, ages 11-17
Youth Substance Abuse	54% reduction in alcohol, tobacco, & marijuana use, ages 12-15
Immunizations	13% increase in full immunization, ages 0-2
TANF Payments	7% reduction through year 13 post-partum; no effect thereafter
Food Stamp Payments	10% reduction through at least year 15 post-partum
Person-months of Medicaid Coverage Needed	8% reduction through at least year 15 post-partum due to reduced births and increased program graduation
Costs if on Medicaid	9% reduction through age 18
Subsidized Child Care	Caseload reduced by 2.9 children per 1,000 families served

For yes-no outcomes (for example was the birth premature), Miller (2015) pooled the data from the trials and computed the percentage change across all trials that assessed this outcome. To pool data, Miller (2015) added the numbers of yes answers in the treatment groups and separately in the control groups, as well as the number of no answers. Miller then computed the percentage change in yes answers between NFP families and control families across the trials. Pooling is a form of meta-analysis. It is more accurate than simply averaging the percentage changes in the NFP groups in different trials relative to controls because it accounts for the different number of families participating in each trial. It also allows assessment of the statistical significance of the outcome across trials.

- **Reduced Smoking During Pregnancy:** NFP mothers smoke 24.5% less tobacco during their pregnancy.

*Evidence:*

- 28% fewer cigarettes smoked in Elmira based on self-report and cotinine (an accurate measure of nicotine intake) (Olds et al. 1986)
- Self-reported smoking declined slightly in Memphis but the difference did not approach statistical significance (personal communication with Dennis Luckey, April 2012)
- 31% less cotinine in Denver (Olds et al. 2002)

**Table 2. NFP Outcomes per 1000 Families Served in California, by Age of the Child in Months**

	Prenatal	0-11	12-23	24-35	36-47	48-59	60-71	72-83	84-95	96-107	108-119	120-131	132-143	144-155	156-167	168-179	180-191	192-203	204-215	Total
Smokers Abstaining While Pregnant	3																			3
Reduced Preeclampsia	69																			69
Fewer Preterm First Births	19																			19
Fewer Subsequent Closely Spaced Pregnancies			66	20	20															107
Fewer Subsequent Preterm Births			18		5	5														28
Reduced Infant/Child Mortality		2.9																		2.9
Fewer Person Years of Intimate Partner Violence	27	41	41	41	41	41														232
Fewer Child Maltreatments						16	16	19	19	19	18	18	18	17	17	17	13			207
Confirmed Incidents						4	4	4	4	4	4	4	4	4	4	4	3			47
Other Incidents						12	12	15	15	15	14	14	14	13	13	17	10			160
Fewer Child Injuries		19	40																	59
Fewer Remedial School Services								160												160
Fewer Youth Crimes																				
Arrests													1	1	4	4	8	10	11	40
Crimes													14	14	14	80	148	186	210	751
Fewer Person-Years of Youth Substance Abuse														52	52	52	52			208
Increased Immunizations			92																	92

\* A person-year means a year when someone avoided one or more harmful incidents.

- 29% fewer cigarettes smoked in the Netherlands based on self-report (40% smoke \* 14.3% fewer cigarettes + 8% quit)/48% of controls smoking) (Mejdoubi et al., 2014)
- In NFP operational programs in PA, mothers who reported on birth certificates that they quit smoking during pregnancy increased 10% during early implementation (p=0.114) and 24% during latter implementation (p=0.001) (Matone et al., 2012a)
- Nationally, of 97,560 NFP mothers surveyed, 12.6% reported they were smoking at intake and 10.6% at 36 weeks, a 16% decline (NFP National Service Office, 2014).

*Rationale for Percentage Chosen:* Cotinine is the gold standard for measuring tobacco use. Therefore, we chose the Denver trial's value (times the 78.9% replication factor). Elmira reported the relationship between self-reported smoking and cotinine level, not NFP's effect on cotinine level. The PA study and NFP data system captured number of smokers rather than quantity smoked. It drew this information from birth certificates which are an unreliable source of smoking data (Northam & Knapp 2006).

- **Reduced Pregnancy-Induced Hypertension:** Pregnancy-induced hypertension (PIH) declined by 31.6%.

*Evidence:*

- 42% reduction in PIH in Elmira, but not statistically significant (Olds et al. 1986)
- 35% reduction in PIH in Memphis (Kitzman et al. 1997)

*Rationale for Percentage Chosen:* We multiplied the pooled 40% reduction in PIH in Elmira and Memphis (95% Confidence Interval (CI) 21.2%, 54.3%) times the 78.9% replication factor.

- **Fewer Preterm First Births:** NFP reduces preterm births (less than 37 weeks) by 14.8%.

*Evidence:*

- Across the 5 US randomized trials, preterm births declined by 18.8%- (p=.053, 95% CI -4.6%, 37.0%). Table 3 and the dot points below summarize the data on preterm births from those trials. Declines were observed in four of five trials, although sample sizes generally were too small for those declines to be statistically significant. The Elmira and Memphis trials included arms that provided home visits only prenatally. Consequently the sample sizes for birth outcomes in those trials are larger than for later outcomes. The published estimates for Elmira excluded non-white mothers. Table 3 substitutes estimates that include them. Counts for Memphis and Denver came from unpublished data supporting published percentage declines. Estimates from the Denver, Elmira, and Memphis trials are regression-adjusted to account for imperfect matching of treatment and control groups. Counts for Louisiana were inferred from sample sizes (Nagle, 2002) and the percentage reduction and its significance (Sonnier, 2007).
- In Denver, although low birth weight declined by 56%, preterm delivery rose by 2.3% (Olds et al. 2002)
- In Elmira, including data on nonwhite mothers that were omitted from Olds et al. (1986), preterm births declined by 2.8% (Miller 2015). In published Elmira data on white mothers, preterm births decreased by 72% among participants other than

older non-smokers including a 79% decline among smokers. Preterm births were eliminated among girls under age 17 (Olds et al. 1986)

- In Memphis preterm delivery declined by 14.0% (Kitzman et al. 1997)
- In the Louisiana trial, preterm births declined significantly by 52.3% (Sonnier 2007)
- In Orange County CA’s all-Latina study, compared to mothers in a randomly assigned comparison group that received the health department’s standard 3 home visits, preterm births declined 47.2% among NFP mothers (Nguyen et al. 2003)

**Table 3. Number of births and percentage preterm in NFP control and treatment groups in 5 US randomized trials, percentage change in the treatment group risk of preterm relative to the control group, and 95-percent confidence interval for the risk change**

Trial	Control Cases	%Pre-term	Treatment Cases	%Pre-term	Relative Risk Change	95% Confidence Interval
Denver	237	10.1%	222	10.4%	2.3%	[-75.9%, 40.5%]
Elmira	160	7.5%	192	7.3%	-2.8%	[-104.2%, 53.7%]
Louisiana	88	12.5%	151	6.0%	-52.3%	[-10.5%, 79.4%]
Memphis	633	12.0%	426	10.3%	-14.0%	[-22.1%, 39.4%]
Orange County	85	8.2%	69	4.3%	-47.2%	[21.0%, 94.0%]
TOTAL	1203	10.8%	1060	8.8%	-18.8%	[-4.6%, 37.0%]

Source: Miller (2015). When multiple birth resulted from the first pregnancy, only the first-born is counted. Olds et al. (1986) excluded 24 births in Elmira based on decisions of a pediatrician co-author who was blinded to group number.

- In incomplete data from the Netherlands, only 7.0% of births were preterm in the control group, far lower than the 10.8% across US control groups. Among mothers in NFP, the preterm rate was 8.6%, a 23% increase that was not statistically significant (Mejdoubi et al., 2013)
- NFP National Service Office tracking data for 2007-2010 showed that nationally 8.7% of 27,195 singleton births were preterm for mothers in NFP, 29% below the 12.3% rate in a demographically matched sample of other first singleton births (Thorland et al. 2016a).
- In Oklahoma, among single births, relative to all other first-time mothers, NFP participation by 8,598 women was associated with a statistically significant 27.1% reduction in very preterm births under 30 weeks. Among unmarried mothers with no prior pregnancy loss or current pregnancy risk factors, NFP participation was associated with a significant 11% decline in the preterm birth rate, but the rate among married women did not differ significantly between groups (Carabin et al. 2005)
- In central Ohio, relative to an undescribed comparison group, NFP mothers had 37%-45% fewer preterm deliveries (and 30%-40% fewer neonatal intensive care unit (NICU) days); statistical significance of these changes was not reported but the samples were small (Allen et al. 2010)

*Rationale for Percentage Chosen:* We used the 18.8% decrease across the 5 US randomized trials multiplied times the 78.9% replication factor. We suspect 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 45.8%.

*Evidence:* Modest numbers of adverse birth outcomes make it difficult to detect differences in these outcomes in randomized trials. Although designs are much weaker, these outcomes are more appropriately assessed with analyses of programs operating at scale that have served thousands of families.

- In the Memphis trial through age 9, NFP youth experienced a 77.6% decline in mortality, a decline of 15.6 deaths per 1,000 live births (Olds et al. 2007), which continued through at least age 20 (Olds et al., 2014)
- Among unmarried mothers in Oklahoma, NFP participation by 5,239 women was associated with a 64% reduction in odds of neonatal mortality within 28 days (Carabin et al. 2005) – a reduction of 2.6 deaths per 1,000 live births to similar mothers. Among all 8,598 first-time mothers served, the reduction was 47.5% or 2.64 deaths per 1,000 live births. This reduction persisted as children aged
- In Oklahoma, the infant mortality rate for 12,474 NFP babies in Oklahoma was 58% lower than the rate for all other first-born children (Cox 2006)
- Through 2005, odds of death among 15,102 NFP children born in Oklahoma in 1997-2004 were 46% below odds among other Oklahoma first-born children (Cox 2007)
- In Cincinnati, more than 1,665 women enrolled in NFP or a second home visitation program experienced 59%-62% lower odds of infant mortality than other women (Donovan et al. 2007)
- The Oklahoma and Cincinnati rates are suspect because the comparison groups are not equivalent. Program targeting means NFP mothers are at higher risk than most comparison mothers, but they probably are at lower risk than the roughly 50% of mothers offered NFP services who decline them

*Rationale for Percentage Chosen:* We chose the 58% (95% CI 44%-70%) mortality reduction from Cox's Oklahoma 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 77.6% reduction in Memphis through age 9. Although most evidence came from operational programs, the comparison group biases led us to reduce effectiveness with the 78.9% replication factor.

- **Improved Birth Spacing:** During 48 months after the first birth, within 15 months after a birth, NFP mothers have 36% fewer closely spaced pregnancies and 24% fewer very closely spaced births, thus reducing risks of costly complications.

*Evidence:*

- 40% (11.2 percentage point) reduction in closely spaced second births (within 24 months of the first birth) (95% CI 24%, 53%) in pooled data from the Elmira, Memphis and Denver trials (Miller 2015)
- 41% of births to control group mothers and 25% of births to NFP mothers were closely spaced (within 24 months of a prior birth) in Memphis during months 25-48 post-partum, a 40% (16 percentage point) reduction.
- 46% (33 percentage point) reduction in the sum of closely spaced births plus pregnancies that never resulted in live birth (e.g., due to miscarriage) within 48 months of the first birth (95% CI 38%, 52%) in pooled data from the Elmira,

Memphis and Denver trials (Miller 2015, Kitzman et al. 1997, Olds et al. 1988, Olds et al. 2002; this calculation assumes the percentages of control group and NFP births in months 25-48 that were closely spaced in Memphis apply in Elmira and Denver).

- 33% reduction in pregnancies within 14 months of the first birth in Louisiana (Sonnier 2007; not statistically significant, base level unstated)
- 13% (2.2 percentage point) reduction in second births within 2 years in Pennsylvania scale-up including a 27% (5.4 percentage point) reduction among mothers enrolled before age 19 (Rubin et al. 2011); among Latinas, reductions in closely spaced second pregnancy were 39.4% (2.8 percentage points) within 6 months of first delivery and 11.2% (2.9 percentage points) with 18 months (Yun et al. 2014).
- 31% (10 percentage point) reduction in subsequent pregnancy within 18 months relative to other first-time mothers in New York City (NYC Nurse-Family Partnership E-News, September 2011)
- With spotty follow-up, roughly 17% of 45,000 NFP mothers nationwide report a second pregnancy within 15 months (NFP National Service Office, 2014), comparable to the 16.8% of NFP mothers in the 3 pooled randomized trials
- 31% (10 percentage point) reduction in pregnancies within 7 months of delivery during 48 months after the first birth in Memphis (Kitzman et al. 1997)
- 30% (3 percentage point) reduction in second pregnancies within 7 months of delivery in Denver (Olds et al. 2002)

*Rationale for Percentages Chosen:* The pooled estimate of reduced close spacing from the Elmira, Memphis and Denver trials is of highest quality. Applying the 78.9% replication factor yields a 36.1% rate of reduced closely spaced pregnancies in scale-up, close to the 27% rate for young mothers in PA and the 31% rate in New York City. The 24% estimate of reduced very close spacing comes from pooled Denver and Memphis data (30.5% times 78.9%). The strong evidence that close spacing is reduced increases our confidence that very close spacing is reduced.

- **Fewer Subsequent Preterm Births:** On average, NFP mothers have 0.0273 fewer subsequent preterm births.

*Evidence:* This is a computed estimate from Miller (2015). The computation accounted for the preterm birth rate for any subsequent birth and the rate elevation for closely spaced births. It proceeded in three steps. Step 1 computed preterm birth rates by marital status and used data on marital status of NFP recipients to estimate how many of the closely spaced subsequent births avoided would have been preterm absent close spacing. Step 2 adjusted for close spacing. Step 3 estimated the additional reduction resulting from the decline in very closely spaced births beyond the second birth.

Pregnancy spacing below 18 months raises risk of preterm birth by 1.92% per month less than 18 months (Conde-Agueldo et al. 2006). Applying the inter-pregnancy interval distribution for controls in Denver (Olds 2010), the 0.066 births reduced had an average excess probability of being preterm of 18.9%. Since only 0.025 very closely spaced second births were prevented, preventing 10 very closely spaced births over 4.5 years per 11.2 births in Memphis within 2 years means another 0.075 closely spaced births were prevented over the following 2.5 years. These births have a 23% preterm rate (Conde-Agueldo et al. 2006). Subsequent preterm births prevented per NFP family total 0.045

$(0.094 * (14.3\% + 18.9\%) + 0.075 * 23\%)$ ). Multiplying the 0.045 reduction times the 78.9% replication factor, the expected reduction is 0.0273 or 27.3 per 1,000 NFP families.

- **Increased Breastfeeding Attempts:** 7.7% percentage point (11.3%) increase in mothers who tried breastfeeding.

*Evidence:*

- 5 percentage point (16%) increase in white mothers breastfeeding at 6 months in Elmira, data for non-whites not reported (Olds et al. 1983)
- 10 percentage point (62.5%) increase in breastfeeding initiation in Memphis with no change in average duration for initiators (Kitzman et al. 1997)
- 7 percentage point (117%) increase in breastfeeding at 6 months in the Netherlands and a not-statistically-significant 4 percentage point (5%) increase in breastfeeding initiation (Mejdoubi et al., 2014)
- 10 percentage point (33.3%) increase in infants breastfed exclusively for at least 2 months postpartum in New York City compared to other first-time Medicaid mothers citywide (NYC Nurse-Family Partnership E-News, May 2012).
- 11 percentage point (15.3%) increase in initiation among new mothers served by NFP in 2007-2010 relative to a demographically matched control group (Thorland et al. 2016b). Evidence was mixed about whether increased initiation increased breast-feeding rates at 6 to 12 months post-partum

*Rationale for Percentage Chosen:* In pooled Elmira and Memphis data, breastfeeding rose 9.7 percentage points (95% CI 3.7%, 16.0%). Multiplying times the 78.9% replication factor yields an estimated 7.7% percentage point increase. This estimate is lower than the observed 10-11.6 percentage point increase in operational programs so it should be conservative.

- **Reduced Intimate Partner Violence (IPV):** 16.1% reduction in IPV through child age 4.

*Evidence:*

- Cumulative IPV that respondents remembered at 15 years post-partum did not differ significantly between NFP and control mothers in Elmira (Eckenrode et al., 2000); quantitative estimates not reported)
- IPV probability in the NFP cohort in Memphis was 2% lower from birth through year 5 post-partum (based on 6-year recall), 13% lower in years 6-9, and 4% higher in years 9-12. but these differences were not statistically significant (Olds et al., 2007; Olds et al., 2010; Olds et al., 2004b)
- NFP reduced the probability of IPV in Denver in the preceding 6 months by 18.9% at child age 6 months, -6.0% at age 12 months, 4.5% at 21 months, 50.3% at age 4, 16.0% at age 6, and 3.1% at age 9 (personal communication of preliminary estimates, Michael Knudtson, July 2014; Olds et al., 2004a). The decreases generally were not statistically significant. Unlike in other trials, the Denver trial only asked women with partners about IPV. We adjusted the estimates, assuming zero IPV for women without partners.
- Relative to controls, those receiving traditional NFP in the Louisiana trial reported a 13% lower probability of prenatal IPV with the current partner (on a question that appears to have included violence before NFP services started) and a 31.2% lower IPV probability in the first 6-8 months post-partum,  $p=0.26$  (Nagle, 2002; Sonnier, 2007)



- In the Dutch trial, with NFP, the probability of physical assault by an intimate partner was 31.7% lower between the date of trial entry and delivery and 40.5% lower during months 13-24 post-partum (Mejdoubi et al., 2013)
- Nationally, of 83,313 NFP mothers surveyed, physical assault by an intimate partner had declined 37.9% from intake levels by 36 weeks (NFP National Service Office, 2014)

*Rationale for Percentage Chosen:* Violent victimization is subject to recall bias (Bushery, 1981). Therefore, we favored 6-month over 3 year recall in Denver. As Miller (2015) details, we adjusted recall beyond 6 months for recall bias and computed 6-month victimization rates from longer-term reports. Pooling 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, 26.9% at age 4, 12.5% at age 6, and 15.1% at age 9. The estimates at ages 6 and 9 were not significant at even the 80% confidence level, so we assumed reductions ended at age 4. Pooling US estimates, from ages 0-4, IPV was reduced by 20.6% (95% CI 1.1%, 36.1%) (23.4% including the Dutch study). Multiplying 20.6% times the 78.9% replication factor suggests a 16.2% reduction in replication. We defined IPV rates per 6-month period absent NFP as the 13.7% post-natal probability and 18.1% prenatal probability in the pooled control groups from US trials.

- **Fewer Childhood Injuries:** NFP babies have 32.9% fewer injuries treated in emergency departments (EDs) or admitted to hospital through age 2.

*Evidence:*

- 33% reduction in ED visits for injury and 30% reduction in all ED visits in Elmira through age 2 (Olds et al. 1986)
- 39% reduction in hospital-attended injuries in Memphis through age 2 (Kitzman et al. 1997; unpublished 2006 reanalysis with improved statistical methods)
- Similar administrative data were not collectable in Denver
- 50% reduction in all ED use through age 15 months in Louisiana (Sonnier 2007).
- In contrast, NFP client families in Pennsylvania used 15% more ED services for injury through age 2, with the increase attributable to more frequent treatment of minor injuries (Matone et al. 2011)

*Rationale for Percentage Chosen:* Multiplying the 41.6% weighted average reduction (95% CI 32.4%, 49.6%) across 3 trials times 78.9% suggests a 32.9% reduction in replication.

- **Fewer Child Maltreatments:** NFP reduces child abuse and neglect by 31.3% from birth through at least age 15.

*Evidence:*

- 39.7% reduction in cases substantiated by Child Protective Services (CPS) in Elmira (Eckenrode et al. 2000). Cases where the mother was the perpetrator declined by 48% (Olds et al., 1997). 25% reduction in children ever maltreated, including a 55% reduction in the low-income subsample (Zielinski, Eckenrode, & Olds, 2009). Temporally, reductions were concentrated at ages 4 through 15 (Zielinski et al. 2009)
- 43.3% reduction in reports to Child Protective Services at ages 0-36 months (Mejdoubi et al. 2015)
- Similar data were not collected in other trials

*Rationale for Percentage Chosen:* We multiplied the 39.7% U.S. reduction times the 78.9% replication factor. Child maltreatment follows a severity distribution so we assume unconfirmed case counts will change as confirmed (substantiated or otherwise indicated) counts do. That assumption is conservative because NFP increases detection and evidence required for confirmation (Olds et al. 1995), which should cause a larger decrease in unconfirmed than confirmed cases.

- **Better Language Development:** NFP reduces language delay by 39.5%, thus reducing the need for pre-school or school-based remedial services.

*Evidence:*

- In Elmira, stimulation of language development rose significantly by 20% at 34 months of age and 11% at 46 months of age (Olds et al. 1994)
- Language development (receptive vocabulary, coherent story-telling) test scores at age 6 significantly improved by 3%-5% in Memphis but remedial service use was not evaluated (Olds et al. 2004b)
- 50% reduction in language delay at age 2 (Olds et al. 2002) and at age 4 (Olds et al. 2004a) and 0.203 (35%) fewer remedial services/youth at age 6 (Olds 2010) in Denver
- Gains in language development occurred almost exclusively among children of mothers who were more psychologically vulnerable. At least in Memphis, those gains improved achievement test scores in reading and math during grades 1 to 6 (Olds et al. 2010)

*Rationale for Percentage Chosen:* We multiplied the 50% reduction in Denver (95% CI 2.4%-74.4%) times the 78.9% replication factor.

- **Fewer Youth Criminal Offenses:** NFP reduces youth arrests by 24.2% at ages 11 through 19, with reduced arrests of girls predominating and arrest probabilities equalizing by age 19. That self-reported reduction, in turn, saves state and local government police investigation, adjudication, and sanctioning costs, as well as reducing Medicaid spending and tax losses associated with crime victims' earnings losses.

*Evidence:*

- 57% reduction in Elmira (95% CI 43%, 67%) (Eckenrode et al. 2010)
- 12% reduction in self-reported arrests at ages 12-17 in Memphis (95% CI -13%, 32%) (Olds et al. 2016)

*Rationale for Percentage Chosen:* We multiplied the pooled 31% (95% CI 16%-43%) reduction in Elmira and Memphis times the 78.9% replication factor. We assumed the reduction in arrests mirrored the reduction in crimes committed. Both studies find the reductions mainly occur among females.

- **Reduced Youth Substance Abuse:** NFP reduces alcohol, tobacco, and marijuana use by 53.7% at age 12 until age 15.

*Evidence:*

- 67% reduction in 6-month-use of cigarettes, alcohol or marijuana at ages 12-15 in Elmira (Olds et al. 1998; reanalyzed as a combined estimate). Not sustained at age 19 (Eckenrode et al. 2010)
- 69% reduction in 30-day-use of cigarettes, alcohol or marijuana at age 12 in Memphis, with both days of use and number of substances used reduced (Kitzman et al. 2010), but no reduction at age 17 (Olds et al. 2016)

*Rationale for Percentage Chosen:* We multiplied the 68% average reduction times the 78.9% replication factor.

- **Increased Immunizations:** NFP participation is associated with at least a 9.2 percentage point (13.1%) increase in probability that children covered by Medicaid will have complete immunizations at age 2.

*Evidence:*

- In Elmira, the complete immunization rate at age 2 with NFP was 78.4%, a 17.4% (11.6 percentage point) increase over the 66.8% rate among the control group of families not provided with transportation to medical care ( $p=.14$ ) and a 13.3% (9.2 percentage point) increase over the 69.2% rate in pooled data from both control groups ( $p=.16$ ). The data reported were for white families only (Olds et al., 1983)
- In Memphis, a 3% (2 percentage point) increase in complete immunizations at age 2 was not statistically significant (Kitzman et al., 1997). This estimate is contaminated because the trial reminded controls about and transported them to immunizations.
- In New York City, 94% of NFP babies were fully immunized at age 2 compared to 75% of other babies, a 19 percentage point difference (personal communication, Lindsay Senter, New York City Department of Health and Mental Hygiene, August 9, 2010)
- Nationally, average nurse-verified full immunization rates at ages 6-24 months for 8,139 infants born in 2007-2010 who received NFP services were 11.1 percentage points higher than self-reported rates in a comparison group matched on demographics including income (92.1% versus 81.0%) (Thorland et al. 2016b)
- Nationally, among children NFP served in 2007-2013, nurse-assessed immunization rates were 88% at 6, 12, and 18 months, and 92% at 24 months (80% to 84% of all active participants, with 8% not assessed). By comparison, 70% of 24-month-olds served by Medicaid HMOs in 2010 were fully vaccinated (National Committee for Quality Assurance 2011), a 22 percentage point difference

*Rationale for Percentage Chosen:* We multiplied the 11.6 percentage point reduction versus Elmira controls without transport assistance times the 78.9% replication factor. Although the operational program comparisons found larger, statistically significant differences, we favored the more precisely controlled randomized trial data.

- **Reduced TANF Payments:** NFP reduces Temporary Assistance for Needy Families (TANF) payments by 7.0% for 13 years post-partum. These savings result from the reduced second birth rate and differences in earning patterns that reduce TANF eligibility and payments per eligible family. Applying this percentage to current TANF data accounts for the downward shift in TANF participation following the 1996 overhaul of TANF.

*Evidence:*

- In Elmira, 34% reduction in payments (Glazner, Bondy, Luckey, & Olds, 2004) through age 15 and 33% reduction in months of participation per family (Olds et al., 1997) on the earlier Aid to Families with Dependent Children program which had looser eligibility rules than TANF
- In Memphis, 14.8% reduction in TANF payments and 9.1% reduction in TANF participation through age 13 post-partum (Olds et al., 2010; Olds et al. 2016)

- In Denver, 3.0% reduction in TANF payments through age 4 (Glazner et al., 2004) and 3% reduction in months on TANF through age 6 (Olds et al., 2002; Olds et al., 2004b, 2005), not statistically significant

*Rationale for Percentage Chosen:* We multiplied the 8.9% average reduction for the TANF-specific Memphis and Denver evaluations times the 78.9% replication factor. We applied this percentage to the state-specific TANF utilization rate in 2014 multiplied times the state-specific change in payments per recipient family from 1996 to 2014.

- **Reduced Food Stamp Payments:** NFP reduces food stamp usage by 9.7% for 15 years post-partum. These savings result from the reduced second-birth rate and differences in earning patterns that reduce food stamp eligibility and payments per eligible family.

*Evidence:*

- 15% reduction in months on food stamps in Elmira through age 14 (Olds et al. 1997)
- 10.8% reduction in food stamp payments in Memphis through age 15 (Olds et al. 2010, Olds et al. 2016)
- 10.9% cost reduction in Denver through age 4, not statistically significant (Glazner et al., 2004); participation months not reported at ages 0-2

*Rationale for Percentage Chosen:* We multiplied the 12.2% average reduction across the 3 trials times the 78.9% replication factor.

- **Reduced Need for Medicaid Coverage:** NFP reduces person-months on Medicaid by 7.7% for at least 15 years post-partum, with most of 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 fully graduate today because the Child Health Insurance Program and Affordable Care Act raised many state income eligibility thresholds). Second, NFP mothers bear slightly 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 for these second babies.

*Evidence:*

- 13% reduction in Medicaid spending in Elmira over 15 years post-partum (Olds et al. 1997)
- 9.5% reduction in person-months on Medicaid due to graduation from capitated managed care in Memphis over 12 years post-partum (Olds et al. 2010)
- 6.8% reduction in person-months on Medicaid due to graduation from capitated managed care in Denver over 4 years post-partum (Glazner et al., 2004), not statistically significant

*Rationale for Percentage Chosen:* We multiplied the 9.8% average reduction across the 3 trials times the 78.9% replication factor.

- **Lower Costs if on Medicaid:** NFP reduces Medicaid spending per child recipient an estimated 8.5% from birth through age 18 (estimated 95% CI 4.5%, 12.5%).

*Evidence:*

- 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. Although data availability prevented direct evaluation of the savings in the randomized trials, we modeled the savings. Some cost reductions should continue for 18 years post-partum.

*Rationale:* The Government Cost fact sheet estimates the reduction in Medicaid costs. We divided that total by the sum of costs per Medicaid live birth (Institute of Medicine 2006; Machlin & Rohde 2007) plus the present value of annual Medicaid spending per child recipient from birth through age 18 (Henry J. Kaiser Family Foundation 2016a).

- **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.

*Evidence:* This is a computed estimate.

*Computations:* 4.85% of Medicaid and SCHIP children use subsidized child care nationwide (Office of Child Care 2010). We multiplied that rate times the 0.0599 reduction in subsequent births (derived above).

**State Adjusters.** Table 4 lists sources for adjusters used to derive state effectiveness estimates from the national estimates. The adjusters are multipliers computed as the state value divided by the national value.

**Table 4. Adjusters Used to Estimate California Incidence Rates from National Incidence Rates**

	<b>State-Specific Adjusters (ratio state to US value)</b>	<b>Source</b>
Smoking During Pregnancy	% smoking in the last trimester	2014 birth certificate data adjusted for under-reporting
Preterm First Births	Preterm birth rate	Henry J Kaiser Family Foundation (2016b)
Subsequent Births	Repeat birth rate for teenaged mothers	Child Trends (2011)
Subsequent Preterm Births	Preterm birth rate; repeat birth rate for teenaged mothers	Henry J Kaiser Family Foundation (2016b); Child Trends (2011)
Child Maltreatment	Substantiated child maltreatment cases/1000 children	Children’s Bureau (2016)
Youth Criminal Offenses	Arrests/1000 youth	Bureau of Justice Statistics (2016)

**Limitations.** Because child mortality is rare, we estimated reductions primarily with models or comparisons between NFP babies and other babies. These estimates are less certain than ones from randomized trials that compare NFP and well-matched control babies. The analysis assumes findings from Elmira, Denver, and Memphis apply nationwide. Despite consistent evidence for selected effects in state and nationwide programs, that may be questionable with Asian and Native American families and possibly in rural settings.

**References.** Please see the references fact sheet.

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*DA021624 and the NFP National Services Office. The views expressed are those of the author and do not necessarily reflect the funder's views.*

Calculator Date: 12/29/2018

Fact Sheet Date: 2/20/2019 16:10