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**The Nurse-Family Partnership:
From Trials to Practice**

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Abstract

Pregnancy and the early years of the child's life offer an opportune time to prevent a host of adverse maternal, child, and family outcomes that are important in their own right, but that also reflect biological, behavioral, and social substrates in the child and family that affect family formation and future life trajectories. This paper summarizes a 30-year program of research that has attempted to improve early maternal and child health and future life options with prenatal and infancy home visiting by nurses. The program is designed for low-income mothers who have had no previous live births. The home visiting nurses have three major goals: to improve the outcomes of pregnancy by helping women improve their prenatal health; to improve the child's health and development by helping parents provide more sensitive and competent care of the child; and to improve parental life-course by helping parents plan future pregnancies, complete their educations, and find work.

The program has been tested in three separate large-scale randomized controlled trials with different populations living in different contexts. Results from these trials indicate that the program has been successful in achieving two of its most important goals: the improvement of parental care of the child as reflected in fewer injuries and ingestions that may be associated with child abuse and neglect and better emotional, behavioral, and language development on the part of the child leading to superior academic achievement; and the improvement of maternal life-course, reflected in fewer subsequent pregnancies, greater work force participation, and reduced dependence on public assistance and food stamps. The impact on pregnancy outcomes is equivocal. In the first trial, the program also produced long-term effects on the number of arrests, convictions, emergent substance use, and promiscuous sexual activity of 15-year-old children whose nurse-visited mothers were low-income and unmarried when they registered in the study during pregnancy. In general, the impact of the program was greater on those segments of the population who are more susceptible to the problems under examination.

Since 1996, the program has been offered for public investment outside of research contexts. Careful attention has been given to ensuring that organizational and community contexts

are favorable for development of the program; to providing excellent training and guidance to the nurses in their use of the program's visit-by-visit guidelines; to monitoring the functioning of the program with a comprehensive clinical information system; and to improving the performance of the programs over time with continuous improvement strategies.

INTRODUCTION

Many of the most intractable problems faced by young children and parents in our society today are uniquely associated with adverse maternal health-related behaviors during pregnancy, dysfunctional infant caregiving, and stressful environmental conditions that interfere with parental and family functioning. These problems include infant mortality, pre-term delivery, low birthweight, and neurodevelopmental impairments in young children resulting from poor conditions for pregnancy; child abuse and neglect; accidental childhood injuries; youth violence; closely spaced pregnancy, and thwarted economic self-sufficiency of parents. In a series of randomized trials conducted in Elmira, New York, Memphis, Tennessee, and Denver, Colorado, our team has been examining the impact of a program of prenatal and early childhood home visitation by nurses as a means of improving parental behaviors and environmental conditions early in the life cycle in an effort to prevent these maternal and child health problems. The conduct of these trials has enabled us to examine the extent to which the effects of the program are consistent across these different populations, settings, and time periods. The Denver trial was designed to determine the extent to which lay community health visitors might be able to produce the same beneficial effects as nurses when they were trained in the same program model.

The program of research reported here was guided by both epidemiology and developmental theory. Many early preventive interventions fail because they are not based on a thorough understanding of: (i) the risk and protective characteristics in the targeted population as they relate to the outcomes of interest; (ii) the likely developmental pathways leading to the negative outcomes they intend to prevent and the positive outcomes they intend to promote; and (iii) the mechanisms, based on sound theory and evidence, through which their designers expect the programs to produce behavioral change (Olds & Kitzman, 1993). This paper describes the

empirical and theoretical foundations upon which this program of research was founded; the design of the program itself; and the research designs, methods and findings from the Elmira and Memphis trials. The final section of this paper provides an examination of the policy implications of the findings and describes our current initiative to replicate the program model outside of research contexts while maintaining fidelity to the model tested in the trials.

A Research-Based and Theory-Driven Model

Research-Based

Research has guided decisions about the families to be served and the content of the program. All of the trials have examined program impact with women who have had no previous live births, and each has focused recruitment on women who were low income, unmarried, and adolescents. The primary difference among the studies is that in the Elmira trial any woman bearing a first child was allowed to register. Women with these characteristics were recruited because the problems the program was designed to address (e.g., poor birth outcomes, child abuse and neglect, and diminished economic self-sufficiency of parents) are concentrated in those populations (Elster & McAnarney, 1980; Furstenberg, Brooks-Gunn, & Morgan, 1987; Overpeck, Brenner, Trumble, Trifiletti, & Berendes, 1998). In addition, program effects in Elmira were greater for the higher-risk families, so the subsequent Memphis and Denver trials focused recruitment more exclusively on those with overlapping risks (i.e., being both unmarried and from a low-income family).

All three of the trials focused on women who had no previous live births because it was hypothesized that such women would be more receptive to home-visitation services concerning pregnancy and child rearing than would women who had already given birth. Moreover, as parents learn parenting and other skills through the program, they should be better able to care for subsequent children, and the program should have an even greater positive effect. Finally, if the program helped parents plan subsequent births, then it would be easier for parents to finish their education's and find work because of fewer problems with child care (Furstenberg, et al., 1987), and the children would benefit from more focused parental nurture and guidance (Tygart, 1991).

The content of the program is also research-based. The program seeks to modify specific risks that are associated with the negative outcomes the program seeks to address: poor birth outcomes, child abuse and neglect, injuries, and compromised parental life course.

Figure 1 summarizes how these influences are thought to reinforce one another over time. On the far left side of this figure we note the three broad domains of proximal risks and protective factors that the program was designed to affect: prenatal health related behaviors; sensitive, competent care of the child; and early parental life-course (pregnancy planning, parents' completion of their educations, finding work, and father involvement in the lives of their children). The middle set of outcomes reflects corresponding child and parental outcomes that the program was designed originally to influence: birth outcomes (obstetric complications, preterm delivery, and low birthweight), child abuse, neglect, and unintentional injuries; child neuro-developmental impairment (perturbations in emotional, behavioral, and cognitive development); and later parental life-course (family economic self-sufficiency, welfare dependence, maternal substance abuse). On the far right, we show child and adolescent outcomes that the program might affect years after completion of the program at child age two, including school failure, antisocial behavior, and substance abuse. Part of the program effect on adolescent functioning was thought to be affected by reducing children's exposure and susceptibility to negative peer influences. When our team began this program of research in 1977, we did not allow ourselves to imagine that the changes the nurses attempted to make during pregnancy and the first two years of the child's life might really have an impact on adolescent outcomes. Nevertheless, results of the Elmira trial summarized below indicate that the program indeed affected adolescent behavior. Each of these sets of influences is discussed in greater depth below.

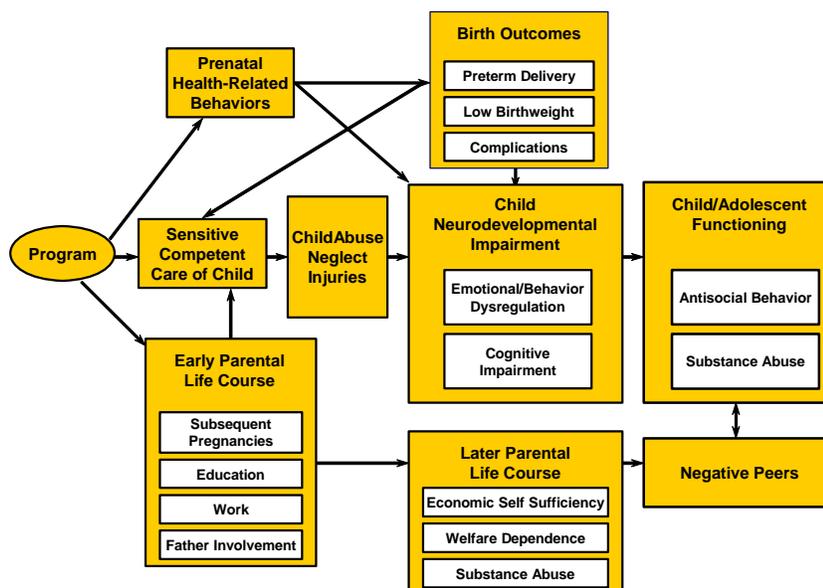


Figure 1. Conceptual Model of Program Influences on Maternal and Child Health and Development

Prenatal Health Behaviors: Modifiable Risks for Poor Birth Outcomes and Child Neurodevelopmental Impairment. Prenatal exposure to tobacco, alcohol, and illegal drugs are established risks for poor fetal growth (Kramer, 1987) and, to a lesser extent, preterm birth (Kramer, 1987) and neurodevelopmental impairment (such as attention- deficit disorder, or poor cognitive and language development) (Olds, 1997; Olds, Henderson, & Tatelbaum, 1994a; Olds, Henderson, & Tatelbaum, 1994b; Streissguth, Sampson, Barr, Bookstein, & Olson, 1994) (Fried, Watkinson, Dillon, & Dulberg, 1987; Mayes, 1994; Milberger, Biederman, Faraone, Chen, & Jones, 1996). In all three trials (Elmira, Memphis, and Denver) the home visitors therefore sought to reduce mothers' use of these substances. The prenatal protocols also address other behavioral factors that increase the risk for low birthweight, preterm delivery, and poor child development: inadequate weight gain (Institute of Medicine, 1990), inadequate diet (Institute of Medicine, 1990), inadequate use of office-based prenatal care (Klein & Goldenberg, 1990), and early identification

and treatment of obstetric complications, such as genitourinary tract infections and hypertensive disorders (high blood pressure) (Klein et al., 1990).

Sensitive, Competent Care of the Child: Modifiable Risks for Child Abuse and Neglect and Injuries to Children. Parents who empathize with their infants and sensitively read and respond to their babies' communicative signals are less likely to abuse or neglect their children and they are more likely to read their children's developmental competencies accurately, leading to fewer unintentional injuries (Peterson & Gable, 1998). Competent early parenting is associated with better child behavioral regulation, language, and cognition (Hart & Risley, 1995). Later demanding, responsive, and positive parenting can provide some protection from the damaging effects of stressful environments and negative peers (Bremner, 1999) on externalizing symptoms and substance use (Baumrind, 1987; Grant, et al., 2000). In general, poor parenting is correlated with low child serotonin levels (Pine, 2001; Pine, 2003) which, in turn, are implicated in stress-induced delays in neurodevelopment (Bremner & Vermetten, 2004).

While it makes sense to target these proximal behaviors, it is helpful to understand and address the general sets of influences that affect parents' abilities to care for their children. We have hypothesized that these influences on parenting skills can be moderated with targeted intervention strategies.

Parents' care-giving skills are affected by ontogenetic and contextual factors. Parents who grew up in households with punitive, rejecting, abusive, or neglectful caregiving are more likely to abuse or neglect their own children (Egeland, Jacobvitz, & Sroufe, 1988; Quinton & Rutter, 1984; Rutter, 1989). Parents' psychological immaturity and mental health problems can reduce their ability to care for their infants (Newberger & White, 1989; Sameroff, 1983). While it is impossible to change parents' personal histories and it is very difficult to reduce personal immaturity and mental illness, as indicated below, the program has sought to mitigate the effect of these influences on parents' caregiving. In addition, unemployment (Gil, 1970), poor housing and household conditions (Gil, 1970), marital discord (Belsky, 1981), and isolation from supportive family members and friends (Garbarino, 1981) are all associated with higher rates of abuse and neglect, perhaps

because they create stressful conditions in the household that interfere with parents' ability to care for their children (Bakan, 1971; Kempe, 1973). As noted below, the program is designed to improve parents' economic self-sufficiency, help parents find safe housing, improve partner communication and commitment, and reduce social isolation.

Moreover, recent evidence suggests that children's characteristics may affect the degree to which their parents care for them competently. Children born with subtle neurological perturbations resulting from prenatal exposure to substances such as tobacco and alcohol and maternal stress and anxiety during pregnancy are more likely to be irritable and inconsolable and to have difficulty habituating to auditory stimuli in the first few weeks of life (Clark, Soto, & Bergholz, 1996; Saxon, 1978; Streissguth et al., 1994), making it more difficult for parents to find enjoyment in their care. Children with Attention-Deficit Hyperactivity Disorder are at increased risk for becoming seriously injured (DiScala, Lescohier, Barthel, & Li, 1998), a link that may be explained in part by the difficulties parents may have with regulating and guiding their children's behavior. Thus these child characteristics (which are affected to some degree by the quality of the uterine environment) may contribute to parents' abilities to become competent parents. Parents who are mature, married to supportive spouses, who have adequate incomes and few external stressors are more likely to manage the care of difficult newborns better than those parents without these resources. Unfortunately, children with subtle neurological vulnerabilities are more likely to be born into households where these salutary conditions are not present, multiplying the likelihood that care-giving will be compromised.

Early Parental Life Course (Subsequent Pregnancies, Education, Work, and Father Involvement): Modifiable Risks for Compromised Maternal Life-Course Development. One of the major risks for compromised maternal educational achievement and workforce participation is rapid, successive pregnancy, particularly among unmarried women (Furstenberg, et al., 1987). Such pregnancies often occur when women have limited visions for their futures in the areas of education and work (Musick, 1993), as well as a limited belief in their control over their life

circumstances and over their contraceptive practices in particular (Brafford & Beck, 1991; Heinrich, 1993; Levinson, 1986).

One of the more significant questions that young mothers must address is the role that the child's father will play in their lives. As indicated below, the program actively promotes fathers' involvement with their partners and children. In most cases, fathers are eager to be supportive partners and providers for their children. In some cases, they are ambivalent, unprepared, abusive, and involved in criminal activities. Couples who are married are more likely to achieve economic self-sufficiency and their children are at lower risk for a host of problems (McLanahan & Carlson, 2002). It would be a mistake, however, to conclude from this that simply promoting marriage for unmarried pregnant women is the right approach, without considering the quality of the possible relationship and the risk for domestic violence. These decisions are complex and require careful consideration of whether the father (or other prospective partner) can be a good spouse and positive caregiver.

To the extent that families improve their economic conditions over time, they are less likely to live in unsafe, crime-ridden neighborhoods where children are exposed to negative peer influences. And even if children are exposed to negative peers, nurse-visited children are less likely to be susceptible to those negative influences because they will have stronger relationships with their parents, which will have helped them develop a stronger moral core (Emde & Buchsbaum, 1990).

The young women consult with nurses as they make these significant life-shaping decisions. In all of this, the nurses help women envision a future consistent with their deepest values and aspirations; they help women evaluate different contraceptive methods, child-care options, and career choices; and they help women develop concrete plans for achieving their goals.

Early Life-Course Modifiable Risks for Early-Onset Antisocial Behavior. Many of the factors listed above are risk factors for early-onset antisocial behavior (Olds, et al., 1998; Olds, et al., 1998; Olds, 1997; Olds, et al., 1997), a type of disruptive behavior that frequently characterizes

children who grow up to become violent adolescents and, sometimes, chronic offenders (Moffitt, 1993; Raine, Brennan, & Mednick, 1994). For example, children who develop early-onset disorder are more likely to have subtle neurodevelopmental deficits (sometimes due to poor prenatal health) (Milberger, et al., 1996; Olds, 1997; Streissguth et al., 1994; Wakschlag, et al., 1997) combined with abusive and rejecting care early in life (Moffitt, 1993; Raine, et al., 1994). Recent evidence indicates that prenatal tobacco exposure is a unique risk for conduct disorder and youth crime (Brennan, Grekin, & Mednick, 1999; Moffitt, 1993; Wakschlag, et al., 1997). Adverse prenatal influences on fetal neurological development are sometimes exacerbated by adverse postnatal experiences. Children who have been abused are more likely to develop negative attribution biases that make them more likely to interpret ambiguous behaviors on the part of others as threatening (Dodge, Bates, & Pettit, 1990) and to have internal representations of interpersonal relationships characterized by dysregulated aggression and violence (Buchsbaum, Toth, Clyman, Cicchetti, & Emde, 1992) both of which probably reflect an adaptive neurological response to a threatening world (Teicher, 2000). They are more likely to come from large families, with closely-spaced children (Tygart, 1991), where parents themselves are involved in substance abuse and criminal behavior (Moffitt, 1993).

A similar configuration of risks is associated with early-onset Major Depressive Disorder (MDD). Children who develop MDD in childhood, compared to those who develop MDD as adults, are more likely to have perinatal insults, motor skill deficits, behavioral and emotional problems (Jaffee, et al., 2002), especially impulsivity, risky decision making, and problems with verbal recognition memory and inattention (Aytaclar, Tarter, Kirisci, & Lu, 1999), as well as caretaker instability, criminality, and psychopathology in their family of origin.

Both conduct disorder and early substance use increase the risk for later SUDs and chronic antisocial behavior (Boyle, et al., 1992; Clark & Cornelius, 2004; Clark, Cornelius, Kirisci, & Tarter, 2005; Clark, et al., 1997; Lynskey, et al., 2003; Moffitt, 1993; Raine, et al., 1994). Children who begin using cannabis in adolescence (<17 years) are at greater risk for developing SUDs (Lynskey, et al., 2003). Adolescent substance use also is implicated in the development of adult antisocial

behavior (Ridenour, et al., 2002) and depression. The reduction in prenatal risks, dysfunctional care of the infant, and improvement in family context is thus likely to have long-term effects on youth antisocial behavior that has its roots in early experience.

Theory-Driven

As noted in the introduction to this chapter, the NFP is grounded in theories of human ecology (Bronfenbrenner, 1979; Bronfenbrenner, 1995), self-efficacy (Bandura, 1977), and human attachment (Bowlby, 1969). Together, these theories emphasize the importance of families' social context and individuals' beliefs, motivations, emotions, and internal representations of their experience in explaining the development of behavior. The integration of these theories has influenced the design of this program.

Human ecology theory, for example, emphasizes that children's development is influenced by how their parents care for them, and that, in turn, is influenced by characteristics of their families, social networks, neighborhoods, communities, and the interrelations among them (Bronfenbrenner, 1979). Drawing from this theory, nurses attempt to enhance the material and social environment of the family by involving other family members, especially fathers, in the home visits, and by linking families with needed health and human services.

Parents help select and shape the settings in which they find themselves, however (Plomin, 1986). Self-efficacy theory provides a useful framework for understanding how women make decisions about their health-related behaviors during pregnancy, their care of their children, and their own personal development. This theory suggests that individuals choose those behaviors that they believe (1) will lead to a given outcome, and (2) they themselves can successfully carry out (Bandura, 1977). In other words, individuals' perceptions of self-efficacy can influence their choices and can determine how much effort they put forth in the face of obstacles.

The curriculum therefore is designed first to help women understand what is known about the influence of particular behaviors on their own health and on the health and development of their babies. The program guidelines are periodically updated to reflect the most recent evidence regarding influence on family and child health. Second, the home visitors help parents establish

realistic goals and small achievable objectives that, once accomplished, increase parents' reservoir of successful experiences. These successes, in turn, increase women's confidence in taking on larger challenges.

Finally, the program is based on attachment theory, which posits that infants are biologically predisposed to seek proximity to specific caregivers in times of stress, illness, or fatigue in order to promote survival (Bowlby, 1969). Attachment theory hypothesizes that children's trust in the world and their later capacity for empathy and responsiveness to their own children once they become parents is influenced by the degree to which they formed an attachment with a caring, responsive, and sensitive adult when they were growing up, which affects their internal representations of themselves and their relationships with others (Main, Kaplan, & Cassidy, 1985).

The program therefore explicitly promotes sensitive, responsive, and engaged caregiving in the early years of the child's life (Barnard, 1990; Dolezol & Butterfield, 1994). In addition, home visitors try to help mothers and other caregivers review their own childrearing histories and make decisions about how they wish to care for their children in light of the way they were cared for as children. Finally, the visitors seek to develop an empathic and trusting relationship with the mother and other family members because experience in such a relationship is expected to help women eventually trust others and to promote more sensitive, empathic care of their children.

PROGRAM DESIGN

The same basic program design has been used in Elmira, Memphis, and Denver.

Frequency of Visitation

The recommended frequency of home visits changed with the stages of pregnancy and was adapted to the parents' needs. When parents were experiencing crises, the nurses were allowed to visit more frequently. Mothers were enrolled through the end of the second trimester of pregnancy. In Elmira, Memphis, and Denver, the nurses completed an average of 9 (range 0-16), 7 (range 0-18), and 6.5 (range 0-17) visits during pregnancy respectively; and 23 (range 0-59), 26 (range 0-71), and 21 (range 0-71) visits from birth to the child's second birthday. Paraprofessionals in Denver completed an average of 6 (range 0-21) prenatal visits and 16 (range 0-78) during infancy.

Each visit lasted approximately 75-90 minutes.

Nurses as Home Visitors

Nurses were selected to be the home visitors because of their formal training in women's and children's health and their competence in managing the complex clinical situations often presented by at-risk families. Nurses' abilities to competently address mothers' and family members' concerns about the complications of pregnancy, labor, and delivery, and the physical health of the infant are thought to provide nurses with increased credibility and persuasive power in the eyes of family members.

Program Content

During the home visits, the nurses carried out three major activities: (1) they promoted improvements in women's (and other family members') behavior thought to affect pregnancy outcomes, the health and development of the child, and parents' life course; (2) they helped women build supportive relationships with family members and friends; and (3) they linked women and their family members with other needed health and human services.

The nurses followed detailed visit-by-visit guidelines whose content reflects the challenges parents are likely to confront during specific stages of pregnancy and the first 2 years of the child's life. Specific assessments were made of maternal, child, and family functioning that correspond to those stages; and specific activities were recommended to address problems and strengths identified through the assessments.

During pregnancy, the nurses helped women complete 24-hour diet histories on a regular basis and plot weight gains at every visit; they assessed the women's cigarette smoking and use of alcohol and illegal drugs and facilitated a reduction in the use of these substances through behavioral change strategies. They taught women to identify the signs and symptoms of pregnancy complications, encouraged women to inform the office-based staff about those conditions, and facilitated compliance with treatment. They gave particular attention to urinary tract infections, sexually transmitted diseases, and hypertensive disorders of pregnancy (conditions associated with poor birth outcomes). They coordinated care with physicians and nurses in the office and

measured blood pressure when needed.

After delivery, the nurses helped mothers and other caregivers improve the physical and emotional care of their children. They taught parents to observe the signs of illness, to take temperatures, and to communicate with office staff about their children's illnesses before seeking care. Curricula were employed to promote parent-child interaction by facilitating parent's understanding of their infants' and toddlers' communicative signals, enhancing parents' interest in playing with their children in ways that promote emotional and cognitive development, and creating households that are safer for children.

The nurses also helped women clarify their goals and solve problems that may interfere with their education, finding work, and planning future pregnancies.

OVERVIEW OF RESEARCH DESIGNS, METHODS AND FINDINGS

In each of the three studies, women were randomized to receive either home visitation services or comparison services. While the nature of the home-visitation services was essentially the same in each of the trials as described above, the comparison services were slightly different. Both studies employed a variety of data sources. The Elmira sample (N=400) was primarily white. The Memphis sample (N=1138 for pregnancy and 743 for the infancy phase) was primarily black. The Denver trial (n=735) consisted of a large sample of Hispanics and systematically examined the impact of the program when delivered by paraprofessionals (individuals who shared many of the social characteristics of the families they served) and by nurses. We looked for consistency in program effect across those sources before assigning much importance to any one finding. Unless otherwise indicated, all findings reported below have significance levels at least $p < .05$, with 2-tailed tests.

Elmira Results

Prenatal Health Behaviors. During pregnancy, compared to their counterparts in the control group, nurse-visited women improved the quality of their diets to a greater extent, and those identified as smokers smoked 25% fewer cigarettes by the 34th week of pregnancy (Olds, Henderson, Tatelbaum, & Chamberlin, 1986). By the end of pregnancy, nurse-visited women

experienced greater informal social support and made better use of formal community services.

Pregnancy and Birth Outcomes. By the end of pregnancy, nurse-visited women had fewer kidney infections, and among women who smoked, those who were nurse-visited had 75% fewer pre-term deliveries, and among very young adolescents (aged 14-16), those who were nurse-visited had babies who were 395 grams heavier, than their counterparts assigned to the comparison group (Olds, et al., 1986).

Sensitive, Competent Care of Child. At 10 and 22 months of the child's life, nurse-visited poor, unmarried teens, in contrast to their counterparts in the control group, exhibited less punishment and restriction of their infants and provided more appropriate play materials than did their counterparts in the control group (Olds, Henderson, Chamberlin, & Tatelbaum, 1986). At 34 and 46 months of life, nurse-visited mothers provided home environments that were more conducive to their children's emotional and cognitive development as rated by the HOME inventory and that were safer, based upon observations of safety hazards (Olds, Henderson, & Kitzman, 1994).

Child Abuse, Neglect, and Injuries. During the first two years of the child's life, nurse-visited children born to low-income, unmarried teens had 80% fewer verified cases of child abuse and neglect than did their counterparts in the control group (1 case or 4% of the nurse-visited teens, versus 8 cases or 19% of the control group, $p=.07$). During the second year of life, nurse-visited children were seen in the emergency department 32% fewer times (0.74 versus 1.09 visits), a difference that was explained in part by a 56% reduction in visits for injuries and ingestions (0.15 versus 0.34 visits).

The effect of the program on child abuse and neglect in the first two years of life and on emergency department encounters in the second year of life was greatest among children whose mothers had little belief in their control over their lives when they first registered for the program.

During the two years after the program ended, its impact on health-care encounters for injuries endured: irrespective of risk, children of nurse-visited women were less likely than their control group counterparts to receive 35% fewer emergency department visits (1.00 versus 1.53

visits) and to visit a physician 40% fewer times for injuries and ingestions (0.34 versus 0.57 visits) (Olds, et al., 1994). The impact of the program on state-verified cases of child abuse and neglect, on the other hand, disappeared during that 2-year period (Olds, et al., 1994), probably because of increased detection of child abuse and neglect in nurse-visited families and the nurses' linkage of families with needed services (including child protective services) at the end of the program at the child's second birthday (Olds, Henderson, Kitzman, & Cole, 1995).

Results from a 15-year follow-up of the Elmira sample (Olds, et al., 1997) indicate that the Group 4-comparison differences in rates of state-verified reports of child abuse and neglect grew between the children's fourth and fifteenth birthdays. During the 15-year period after delivery of their first child, in contrast to women in the comparison group, those visited by nurses during pregnancy and infancy were identified as perpetrators of child abuse and neglect in an average of 0.29 versus 0.54 verified reports per program participant, an effect that was greater for women who were poor and unmarried at registration (Olds, et al., 1997).

Child Neuro-developmental Impairment. At six months of age, nurse-visited poor unmarried teens reported that their infants were less irritable and fussy than did their counterparts in the comparison group (Olds & Henderson, 1989). Subsequent analyses of these data indicated that these differences were really concentrated among infants born to nurse-visited women who smoked 10 or more cigarettes per day during pregnancy in contrast to babies born to women who smoked 10 or more cigarettes per day in the comparison group (Olds, et al., 1998). Over the first four years of the child's life, children born to comparison-group women who smoked 10 or more cigarettes per day during pregnancy experienced a 4-5 point decline in intellectual functioning in contrast to comparison-group children whose mother smoked 0-9 cigarettes per day during pregnancy (Olds, et al., 1994a). In the nurse-visited condition, children whose mothers smoked 0-9 cigarettes per day at registration did not experience this decline in intellectual functioning, so that at ages 3 and 4 their I.Q. scores on the Stanford Binet test were about 4-5 points higher than their counterparts in the comparison group whose mothers smoked 10+ cigarettes per day at registration (Olds, et al., 1994b).

Early Parental Life-Course. By the time the first child was four year of age, nurse visited women low-income, unmarried women, in contrast to their counterparts in the control group had fewer subsequent pregnancies, longer intervals between the birth of the first and second child, and greater participation in the work force than did their counterparts in the comparison group (Olds, Henderson, Tatelbaum, & Chamberlin, 1988).

Later Parental Life Course. At the 15-year follow-up, no differences were reported for the full sample on measures of maternal life course such as subsequent pregnancies or subsequent births, the number of months between first and second births, receipt of welfare, or months of employment. Poor unmarried women, however, showed a number of enduring benefits. In contrast to their counterparts in the comparison condition, those visited by nurses both during pregnancy and infancy averaged 32% fewer subsequent pregnancies (1.5 versus 2.2 pregnancies), 31% fewer subsequent births (1.1 versus 1.6), about 30 months greater intervals between the birth of their first and 2nd children (64.8 versus 37.3 months), about 30 fewer months on welfare (60.4 versus 90.3), about 37 fewer months receiving food stamps (46.7 versus 83.5); and 69% fewer arrests (0.18 versus 0.58) (Olds, et al., 1997).

Child/Adolescent Functioning. The follow-up study also assessed children of the original participants, when the children were 15 years of age (Olds, et al., 1998). Recent re-analyses of the data from the 15-year follow-up (Nurse-Family Partnership, 2006) indicate that among the 15-year-old children of study participants, those visited by nurses had fewer arrests and adjudications as Persons in Need of Supervision (PINS). These effects were greater for children born to mothers who were poor, unmarried at registration. Nurse-visited children, as trends, reported fewer sexual partners and fewer convictions and violations of probation.

Cost Analysis. The Rand Corporation has conducted an economic evaluation of the program that extrapolates the results of the 15-year follow-up study to estimate cost savings generated by the program (Karoly, et al., 1998). While there were no net savings to government or society for serving families in which mothers were married and of higher social class, the savings to government and society for serving families in which the mother was low-income and unmarried at

registration exceeded the cost of the program by a factor of four over the life of the child.

Memphis Results

Prenatal Health Behaviors. There were no program effects on women's use of standard prenatal care or obstetrical emergency services after registration in the study. By the 36th week of pregnancy, nurse-visited women were more likely to use other community services than were women in the control group. There were no program effects on women's cigarette smoking, probably because the rate of cigarette use was only 9 percent in this sample, and women smoked fewer cigarettes per day than did women who smoked in the Elmira trial.

Pregnancy and Birth Outcomes. In contrast to women in the comparison group, nurse-visited women had fewer instances of pregnancy-induced hypertension and among those with the diagnosis, nurse-visited cases were less serious (Kitzman, et al., 1997).

Sensitive, Competent Care of Child. Nurse-visited mothers reported that they attempted breast-feeding more frequently than did women in the comparison group, although there were no differences in duration of breast-feeding. By the 24th month of the child's life, in contrast to their comparison-group counterparts, nurse-visited women held fewer beliefs about child-rearing associated with child abuse and neglect. Moreover, the homes of nurse-visited women were rated on the HOME scale as more conducive to children's development. While there was no program effect on observed maternal teaching behavior, children born to nurse-visited mothers with low levels of psychological resources were observed to be more communicative and responsive toward their mothers than were their comparison-group counterparts (Kitzman, et al., 1997).

Child Abuse, Neglect, and Injuries. The rate of substantiated child abuse and neglect in the population of two-year old, low-income children in Memphis was too low (3-4%) to serve as a valid indicator of child maltreatment in this study. We therefore hypothesized that we would see a pattern of program effects on childhood injuries that would be similar to the pattern observed in Elmira, reflecting a reduction in dysfunctional care of children.

During their first two years, nurse-visited children overall had 23% fewer health-care encounters in which injuries and ingestions were detected than did children in the comparison

group (0.43 versus 0.56), an effect that was accounted for primarily by a 45% reduction in outpatient clinic encounters (0.11 versus 0.20). Nurse-visited children also were hospitalized for 79% fewer days with injuries and/or ingestions than were children in the comparison group (0.04 versus 0.18 days). As illustrated in Figure 2, the effect of the program on injuries and ingestions was greater for children born to women with few psychological resources.

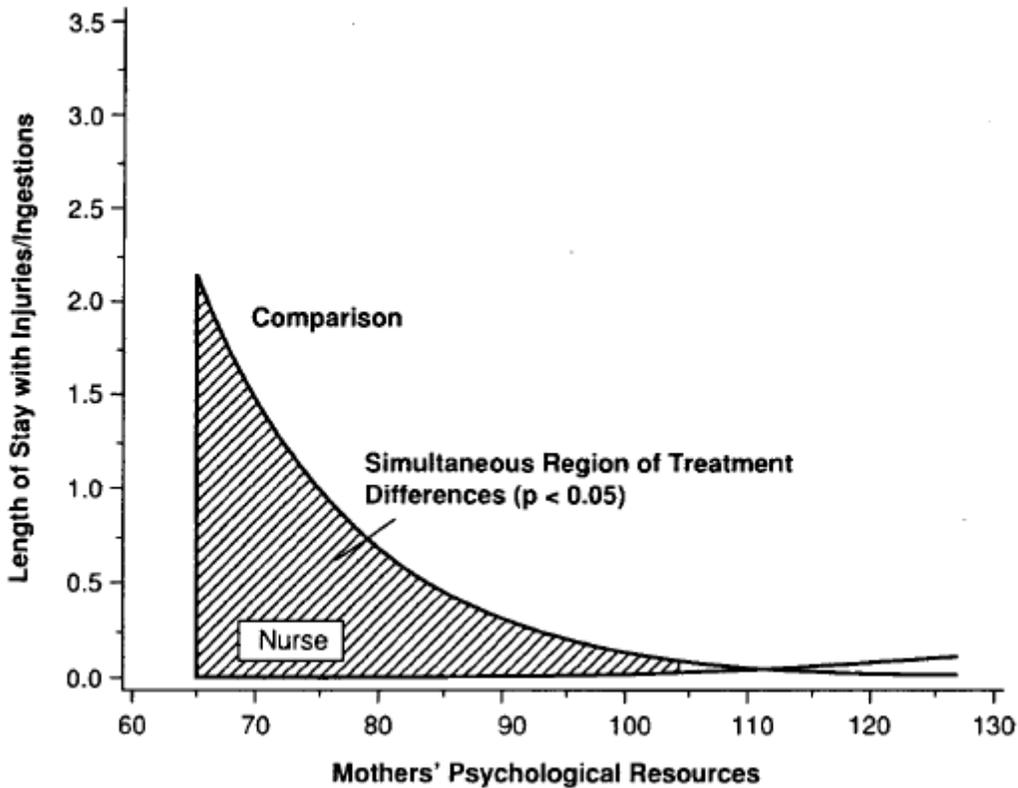


Figure 2. Program impact on days hospitalized with injuries intensified among children born to mothers with limited psychological resources - Memphis

An examination of the children’s hospital records provides insight into reasons that nurse-visited children were hospitalized for fewer days than children in the comparison group (Table 1). Nurse-visited children tended to be older when hospitalized and to have less severe conditions. The conditions that characterized the hospitalizations suggest that many of the hospitalized comparison-group children suffered from more seriously deficient care than children visited by nurses.

Table 1. Diagnoses, child age, sex and length of stay for children’s hospitalizations for injuries or ingestions birth through child age 2 – Memphis.

Diagnosis	Age (in months)	Sex	Length of Hospital Stay (in days)
Nurse-Visited (n = 206)			
First and second degree burns to face	12.0	M	2
Coin ingestion	12.1	M	1
Ingestion of iron medication	20.4	F	4
Comparison Group (n = 465)			
Head trauma	2.4	M	1
Fractured fibula/ congenital syphilis	2.4	M	12
Strangulated hernia with delay in seeking care/ first degree burn to lips	3.5	M	12
Bilateral subdural hematoma ^a	4.9	F	19
Fractured skull	5.2	F	5
Bilateral subdural hematoma (unresolved)/aseptic meningitis—second hospitalization ^a	5.3	F	4
Fractured skull	7.8	F	3
Coin ingestion	10.9	M	2
Child abuse/neglect suspected	14.6	M	2
Fractured tibia	14.8	M	2
Second degree burns to face/neck	15.1	M	5
Second and third degree burns to leg ^b	19.6	M	4
Gastroenteritis/head trauma	20.0	F	3
Burns—second hospitalization ^b	20.1	M	6
Finger injury/osteomyelitis	23.0	M	6

^a One child was hospitalized twice with a single bilateral subdural hematoma

^b One child was hospitalized twice for burns resulting from a single incident

(Reprinted with permission from Kitzman, H., Olds, D., Henderson, C.R., et al. Effect of prenatal and infancy home visitation by nurses on pregnancy outcomes, childhood injuries, and repeated childbearing. A randomized controlled trial. *The Journal of the American Medical Association*, 1997; 278(8): 644–652.)

Overall, nurse-visited children as a trend were less likely to die from birth through age 9 (4.50 vs. 20.08 per thousand, OR=.22, $p=.080$), an effect accounted for by deaths due to potentially preventable causes (Table 2) (Olds, et al., 2007).

Table 2. Causes of Infant and Child Deaths (ICD-9) Among Firstborn Children Through Age 9 (from Olds et al., *Pediatrics*, 120(4), e832-45.)

Cause of Death (ICD-9 Code)	Age at Death, d
Comparison group (n = 498)	
Extreme prematurity (7650)	3
SIDS (7980)	20
SIDS (7980)	35
Ill-defined intestinal infections (90)	36
SIDS (7980)	49
Multiple congenital anomalies (7597)	152
Chronic respiratory disease arising in perinatal period (7707)	549
Homicide assault by firearm (9654)	1569
Motor vehicle accident (8129)	2100
Accident caused by firearm (9229)	2114
Nurse-visited group (n = 222)	
Chromosomal abnormalities (7589)	24

ICD-9 indicates *International Classification of Diseases, Ninth Revision*; SIDS, sudden infant death syndrome.

Child Neuro-developmental Impairment. By child age 6, compared to their counterparts in the control group, children visited by nurses had higher intellectual functioning (92.34 versus 90.24 points, ES = 0.18) and receptive vocabulary scores (84.32 versus 82.13 points, ES = 0.17) and fewer behavior problems in the borderline or clinical range (1.8% versus 5.4%, OR= 0.55). Nurse-visited children born to mothers with low psychological resources had higher arithmetic achievement test scores (88.61 versus 85.42 points, ES = 0.25) and expressed less aggression and incoherence in response to story stems (98.58 versus 101.10 standard score points, ES= -0.25) (Olds, et al., 2004). By child age 9, nurse-visited children born to mothers with low psychological resources, compared to their control-group counterparts, had better grade point averages and achievement test scores (averaging across math and reading) in grades 1–3 (2.68 vs. 2.44, ES=0.22 and 44.89 vs. 35.72, ES=0.33, respectively) (Olds, et al., 2007).

Early Parental Life Course. At the 24th month of the first child’s life, nurse-visited women reported fewer second pregnancies (36% versus 47%, OR=.0.60) and fewer subsequent live births (22% versus 31%, OR = 0.60) than did women in the comparison group. Nurse-visited women and their first-born children relied upon welfare for slightly fewer months during the 2nd year of the child’s life than did comparison-group women and their children (7.8 versus 8.4 months) (Kitzman, et al., 1997).

Later Parental Life-Course. During the 4.5-year period following birth of the first child, in contrast to counterparts assigned to the comparison condition, women visited by nurses had fewer subsequent pregnancies (1.15 versus 1.34), and longer durations between the births of first and second children (30.25 versus 26.60 months); fewer total person-months (based upon administrative data) that the mother and child used Aid to Families with Dependent Children (AFDC) (32.55 versus 36.19 months) and food stamps (41.57 versus 45.04 months); higher rates of living with a partner (43% versus 32%, OR = 1.64) and living with the biological father of the child (19% versus 13%, OR = 1.68). By child age 6, women visited by nurses continued to have fewer subsequent pregnancies (1.16 versus 1.38, ES = -0.22) and births (1.08 versus 1.28, ES = -0.22); longer intervals between births of first and second children (34.38 versus 30.23, ES = 0.26); longer relationships with current partners (54.36 versus 45.00 months, ES = 0.24) and since last follow-up at 4.5 years, fewer months of using welfare (7.21 versus 8.96 months, ES = -0.22) and food stamps (9.67 versus 11.50 months, ES = -0.24). They also were more likely to register their children in formal out-of-home care between age 2 and 4.5 years (82.0% versus 74.9%, OR = 1.53) (Olds, et al., 2004).

By the time the firstborn child was 9 years of age, nurse-visited women had longer intervals between the births of first and second children (40.73 vs. 34.09 months, ES=0.29), had fewer cumulative subsequent births per year (0.81 vs. 0.93, ES = -.14), and had longer relationships with their current partners (51.89 vs. 44.48 months, ES=0.23). From birth through child age 9, nurse-visited women used welfare and food stamps for fewer months (5.21 vs. 5.92 months per year, ES = -0.14; and 6.98 vs. 7.80 months per year, ES = -0.17, respectively) (Olds, et al., 2007).

Denver Results

In the Denver trial, we were unable to use the women's or children's medical records to assess their health because the health-care delivery system was too complex to enable us to abstract reliably all of their health-care encounters as we had done in Elmira and Memphis. This limited the number of health outcomes we could examine in this trial. Moreover, as in Memphis, the rate of state-verified reports of child abuse and neglect was too low in this population (3-4%

for low-income children birth to two years of age) to allow us to use Child Protective Service records to assess the impact of the program on child maltreatment. We therefore focused more of our measurement resources on the early emotional development of the infants and toddlers.

Denver Results for Paraprofessionals

There were no paraprofessional effects on women's prenatal health behavior (use of tobacco), maternal life-course, or child development, although at 24-months, paraprofessional-visited mother-child pairs in which the mother had low psychological resources interacted more responsively than did control-group counterparts. By child age 4, mothers and children visited by paraprofessionals, compared to controls, displayed greater sensitivity and responsiveness toward one another and, in those cases in which the mothers had low psychological resources at registration, had home environments that were more supportive of children's early learning (Olds, et al., 2004). Children of low resource women visited by paraprofessionals had better behavioral adaptation during testing than their control-group counterparts (99.51 versus 96.66 standardized points, $ES = 0.38$). While paraprofessional-visited women did not have statistically significant reductions in the rates of subsequent pregnancy, the reductions observed were clinically significant.

Denver Results for Nurses

The nurses produced effects consistent with those achieved in earlier trials of the program.

Prenatal Health Behaviors. In contrast to their control-group counterparts, nurse-visited smokers had greater reductions in urine cotinine (the major nicotine metabolite) from intake to the end of pregnancy.

Sensitive, Competent Care of Child. During the first 24 months of the child's life, nurse-visited mother-infant dyads interacted more responsively than did control pairs, an effect concentrated in the low-resource group.

Child Neurodevelopmental Impairment. At 6 months of age, nurse-visited infants, in contrast to control-group counterparts, were less likely to exhibit emotional vulnerability in response to fear stimuli and those born to women with low psychological resources were less likely

to display low emotional vitality in response to joy and anger stimuli. At 21 months, nurse-visited children were less likely to exhibit language delays than were children in the control group (6% versus 12%, OR = 0.48), an effect again concentrated among children born to mothers with low psychological resources (7% versus 18%, OR = 0.32). Nurse-visited 24-month olds born to women with low psychological resources also had superior language and mental development in contrast to control-group counterparts (101.52 versus 96.85 and 90.18 versus 86.20, respectively). At child age 4, nurse-visited children whose mothers had low psychological resources at registration, compared to control-group counterparts, had more advanced language (91.39 versus 86.72 points, ES = 0.31), superior executive functioning (100.16 versus 95.48 standard score points, ES = 0.47) and better behavioral adaptation during testing (100.41 versus 96.66 standard score points, ES = 0.38) (Olds, et al., 2004).

Early Maternal Life-Course. By 24 months after delivery, nurse-visited women, compared to controls, were less likely to have had a subsequent pregnancy (29% versus 41%, OR = 0.60) and birth (12% versus 19%, OR = 0.58) and had longer intervals until the next conception. Women visited by nurses were employed longer during the second year following the birth of their first child than were controls (6.87 versus 5.73 months). By child age 4, nurse-visited women continued to have greater intervals between the birth of their first and second children (24.51 versus 20.39 months, ES = 0.32), less domestic violence (6.9% versus 13.6%, OR = 0.47), and enrolled their children less frequently in either preschool, Head Start, or licensed day care than did controls (54.4% versus 65.9%, OR = 0.62) (Olds, et al., 2004).

Estimates of Nurse vs. Paraprofessional Effects

While the program was in operation, for most outcomes on which there was an effect for either program, paraprofessionals produced effects for children that were approximately half the size of those produced by nurses.

SUMMARY OF RESULTS, POLICY IMPLICATIONS, AND PROGRAM REPLICATION

Policy Implications

One of the clearest messages that has emerged from this program of research is that the

functional and economic benefits of the nurse-home-visitation program are greatest for families at greater risk. In the Elmira study, it was evident that most married women and those from higher socioeconomic households managed the care of their children without serious problems and that they were able to avoid lives of welfare dependence, substance abuse, and crime without the assistance of the nurse home-visitors. Similarly, their children on average avoided encounters with the criminal justice system. Low-income, unmarried women and their children in the comparison group, on the other hand, were at much greater risk for these problems, and the program was able to avert many of these untoward outcomes for this at-risk population. Cost analyses suggested that the program's cost savings for government are primarily attributable to benefits accruing to this higher risk group. Among families at lower risk, the financial investment in the program was a loss. This pattern of results challenges the position that these kinds of intensive programs for targeted at-risk groups ought to be made available on a universal basis. Not only is it likely to be wasteful from an economic standpoint, but it may lead to a dilution of services for those families who need them the most, because of insufficient resources to serve everyone well.

During the past decade, new studies have been reported that have led us to doubt the effectiveness of home-visitation programs that do not adhere to the elements of the model studied in these trials (Gomby, Culross, & Behrman, 1999; Olds, Hill, Robinson, Song, & Little, 2000), including especially the hiring of nurses and the use of carefully constructed program protocols designed to promote adaptive behavior (Olds, Hill, O'Brien, Racine, & Moritz, 2003). These results should give policy-makers and practitioners pause as they consider investments in home visitation programs without careful consideration of program structure, content, methods, and likelihood of success.

Recent cost benefit analyses of preventive interventions conducted by the Washington State Institute for Public Policy (WSIPP) have extended earlier cost analyses of the Nurse Family Partnership conducted by the Rand Corporation, which had relied exclusively upon the Elmira data for estimate cost savings (Aos, Lieb, Mayfield, Miller, & Pennucci, 2004). The WSIPP analyses relied upon data from all three trials of the Nurse Family Partnership and estimated that on a per-

family basis, government and society realize a \$17,000 return on investment over the life of the child. It is important to note that many of the early childhood interventions examined in the WSIPP analysis failed to realize a return on investment -- in spite of their beginning early in life, and in some cases in spite of huge per-child investments in preventive services. While early interventions have the potential to produce cost savings, policy makers must choose wisely.

Julia Isaacs, formerly with the Congressional Budget Office employee and now with the Brookings Institution, has recently examined the literature on childhood interventions (Isaacs, 2007). She concludes that America's future economic well-being will benefit from targeted investments designed to ensure that children will have the skills to be productive members of society, and recommends a package of investments over a 5-year period totaling about \$133 billion:

- \$94 billion for high-quality early childhood education for 3- and 4-year olds;
- \$14 billion for nurse home-visiting to promote prenatal care and healthy child development;
- \$17 billion for school reform for programs in high-poverty elementary schools that improve students basic skills; and
- \$8 billion for programs that reduce the incidence of teenage pregnancy.

This kind of bold investment in programs that have strong evidentiary foundations holds the promise to improve the lives of vulnerable children and families and the future life prospects of all of us. Isaacs recommends that a portion of the \$14 billion devoted to nurse home visiting be used to conduct research on improving other home visiting programs that do not yet have the evidentiary foundations that would warrant large public investments.

Replication and Scale-Up of the Nurse Family Partnership

Even when communities choose to develop programs based on models with good scientific evidence, such programs run the risk of being watered down in the process of being scaled up. So, it is with some apprehension that our team has been working to make the program available for public investment in new communities (Olds, et al., 2003). Since 1997, the Nurse Family Partnership national office has helped new communities develop the program outside of traditional

research contexts so that today the program is operating in 280 counties nationally from 190 local operating sites. State and local governments are securing financial support for the Nurse-Family Partnership (about \$4,500 per family per year 2007 dollars) out of existing sources of funds, such as Temporary Assistance to Needy Families, Medicaid, the Maternal and Child Health Block-Grant, and child-abuse and crime-prevention dollars. Sharing the costs among several government agencies reduces the strain on any one agency's budget, but dilutes individual agencies' responsibility for supporting the program, a challenge that exists for many prevention programs (Graycar, 2006).

Each site choosing to implement the Nurse-Family Partnership needs certain capacities to operate and sustain the program with high quality, ideally expanding it gradually to reach a significant portion of the target population. These capacities include having: an organization and community that are fully knowledgeable and supportive of the program; a staff that is well trained and supported in the conduct of the program model; and real-time information on implementation of the program and its achievement of benchmarks to guide efforts in continuous quality improvement. Staff members at the NFP national office are organized to help create these state and local capacities. Information on implementation of the program in community settings is used to improve its performance and the method of replicating it throughout the country.

It is one thing to have evidence that a program model has the potential to improve the lives of children and families. We must invest a corresponding effort in rigorous methods of program replication so we can have assurance that evidence-based models are implemented well in community practice. This will help ensure that the promise of investing in early childhood interventions is realized.

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