

HOME VISITING BY nurses for low-income, at-risk families has been promoted as a promising strategy for preventing child abuse and neglect, children's mental health problems,¹⁻³ and infant mortality.⁴ Recent evidence suggests that the benefits hoped for from such programs do not hold for all types of home-visiting programs.⁵ A program of home visiting by nurses known as the Nurse-Family Partnership (NFP) has produced consistent effects on several aspects of maternal and child health through the preschool period when tested in randomized trials with various racial and ethnic groups, in various living contexts, and at different historical periods.⁶⁻⁸ Many of the apparent benefits of the program that have captured the attention of policy makers, however, have been derived from the adolescent follow-up of the first trial of the NFP, tested with a primarily white sample in Elmira, New York.^{9,10}

The first replication trial of the NFP was conducted in Memphis, Tennessee, and focused on low-income black individuals. Results of the Memphis trial through child age 4 corroborated many of the early effects of the program on maternal life course observed in the first trial that focused on white individuals.^{11,12} A recent study of program effects in Memphis through child age 6 found that the program also produced positive effects on children's cognition, mental health, and internal representations of relationships.⁸ Our study was designed to examine the enduring impact of the program on mothers' life course, on children's academic and behavioral functioning in early elementary school (grades 1-3), and on mothers' reports of their children's mental health through child age 9.

For the current phase of follow-up, we hypothesized that the program would produce enduring effects consistent with those observed either earlier in this trial or in the first trial conducted in Elmira, New York, on primary maternal life-course outcomes: the intervals between births of first and second children, rates of subsequent births (operationalized at this phase of follow-up as the cumulative number of subsequent children born per year), use of welfare (Temporary Assistance for Needy Families [TANF] and food stamps), substance use, behavioral impairments as a result of substance use, arrests and number of days incarcerated, marriage, and duration of partner relations, as well as the biological father's involvement in the family. Better pregnancy planning, maternal employment, sense of mastery, and father involvement, along with reductions in substance abuse, were expected to improve family economic self-sufficiency. To understand fully the clinical and economic impact of these hypothesized changes in maternal life course, we examined the following variables as secondary outcomes: counts of subsequent miscarriages, abortions, still births, and low birth weight newborns; maternal symptoms of depression; and mothers' employment, use of Medicaid, being partnered with men

who were unemployed, and experience of domestic violence.

We hypothesized that the program would produce effects on the following primary child outcomes: grade-point averages (GPAs) in reading, math, and conduct; the counts of failures in academics (reading and math) and conduct, as well as disruptive behavior, anxiety, and depressive disorders; and teachers' reports of antisocial behavior. We also examined as secondary outcomes children's special education placements and grade retentions and teachers' ratings of children's academically focused behavior and peer affiliation. Given limited statistical power, we did not hypothesize program effects on the mortality of firstborn children. We nevertheless examined program effects on this outcome given emerging treatment differences in the rates and causes of mortality.

Earlier reports on trials of this program have found consistent effects on child outcomes concentrated among children who were born to mothers who were more psychologically vulnerable.⁷ We therefore predicted that program benefits for children would be concentrated on those who were born to mothers with low psychological resources (limited intellectual functioning, poor mental health, and low sense of control over their life circumstances). We examined whether program effects on maternal fertility and welfare outcomes were greater for women with initially higher psychological resources, given greater program effects on fertility for this segment of the sample in earlier phases of this trial.^{9,12}

METHODS

We conducted interviews with the children's mothers by telephone ($n = 16$) and in the study of ces at approximately the child's ninth birthday (mean age: 9.73 years; SD: 0.42). We reviewed children's school records in grades 1 to 3 and obtained teachers' (primarily third-grade) reports of children's classroom behavior. The details of basic study design and its implementation have been reported previously^{11,12} and are summarized here.

Table 1 provides the numbers of eligible patients who were (1) invited to participate, (2) randomly assigned, and (3) evaluated at each follow-up assessment. As this table indicates, of mothers who were randomly assigned and had no fetal or child death, follow-up assessments at child age 9 were completed with 91% of the mothers, school records were abstracted for 88% of the children, teacher report forms were completed for 81% of the sample, and achievement-test scores were abstracted for 83%.

Participants

From June 1990 through August 1991, we invited to participate 1290 patients who met study inclusion criteria and were seen consecutively at the obstetric clinic of



the Regional Medical Center in Memphis, Tennessee. We recruited women who were of low income and unmarried because this group benefited the most in the Elmira trial. Women who were at 29 weeks of gestation were recruited when they had no previous live births, no specific chronic illnesses that are thought to contribute to fetal growth retardation or preterm delivery, and at least 2 of the following sociodemographic risk conditions: (1) unmarried, (2) < 12 years of education, and (3) unemployed. Eighty-eight percent (1139) of the 1290 eligible women completed informed consent and were randomly assigned to 1 of 4 treatment conditions described in "Randomization" (2 of which were followed after delivery and form the basis of this report). Ninety-two percent of the women enrolled were black, 98% were unmarried, 64% were 18 years or younger at registration, and 85% came from households with incomes at or below the federal poverty level.

Statistical Power and Assignment Ratios

Sample sizes were established when the trial was first designed from power calculations conducted for pregnancy and infancy outcomes. For all power calculations, we set $\alpha = .05$ and $\beta = .20$ and specified 2-tailed tests.

model with 5 classification factors: maternal race (black

room), standardized to a mean of 100 and an SD of 10. It also formed a single latent variable ($\lambda = .54$).

Primary Maternal Outcomes

The following variables were primary maternal life-course outcomes: interval between birth of first and second children; cumulative subsequent births per year after birth of the first child through the first child's ninth birthday; duration of her relationship with current partner; being partnered with, cohabiting with, or being married to the child's biological father; her sense of mastery; duration of use of welfare (AFDC and TANF) and food stamps per year after birth of the first child; the counts of maternal arrests and days jailed; and the count of substances used (≥ 3 drinks of alcohol ≥ 3 times per month in the past year, use of marijuana, and use of cocaine since last interview at child age 6). We originally included the count of maternal behavioral impairments as a result of substance use as a primary outcome but did not include it given the infrequency of positive responses.

Secondary Maternal Life-Course Outcomes

Other outcomes were examined to help elucidate the functional and economic effects of the hypothesized changes in maternal life course, although such effects were not observed in the Elmira trial by child age 15 or at earlier phases of this trial: the counts of subsequent miscarriages, abortions, and low birth weight newborns; reported participation in the workforce; depression¹⁸; whether they had experienced physical violence from any of their partners since their first child was 6¹⁹; and the portion of time that their current partners were employed while they were together after birth of the first child.

Primary Child Outcomes

We abstracted children's GPAs in reading, math, and behavior (conduct) from their school records. To characterize failed adjustment to early elementary school, we created variables based on the counts of failed GPAs in reading and math (≤ 1.0 for both subjects) and conduct at the end of the school year for each of the children's first 3 grades. We also abstracted the children's achievement-test scores (primarily the Tennessee Comprehensive Assessment Program Achievement Test)²⁰ expressed in percentiles derived from national standards.

We assessed teacher report of antisocial behavior (described in "Secondary Child Outcomes") and maternal report of child disruptive behavior disorders (eg, conduct disorder, oppositional defiant disorder, attention-deficit/hyperactivity disorder) and depressive and anxiety disorders (major depression, dysthymia, generalized anxiety disorder, separation anxiety disorder, and social phobia) for the past year using the Computerized Diagnostic Interview Schedule for Children.²¹ Given low

rates of reported disorders, we used subthreshold diagnoses produced by the Computerized Diagnostic Interview Schedule for Children in addition to diagnoses that

data were available. The primary statistical model consisted of a 2-level treatment factor (treatment 2 vs 4), a 2-level factor reflecting mothers' psychological resources (above versus below the sample median), the interaction

TABLE 2 Adjusted Estimate of Program Effects on Children's Academic Performance, Behavior, and Mental Health Through Child Age 9

Outcomes	Treatment Group		Treatment Comparison
	Comparison, Least-Square Mean (SE)	Nurse-Visited, Least-Square Mean (SE)	Comparison vs Nurse

RESULTS

Baseline Equivalence of Treatment Groups

As shown in Table 3, the treatment groups were similar on background characteristics for participants on whom 9-year follow-up assessments were conducted, with the following exceptions: at intake, nurse-visited women (treatment 4) lived in households with greater levels of poverty and worse scores on childrearing attitudes associated with child maltreatment than did women in the comparison group. These differences suggest that the nurse-visited group at child age 9 had a higher portion of families who had been at risk at enrollment, although, as shown in Table 1, the proportion of families on whom assessments were conducted was high and nearly equivalent across treatment conditions.

Maternal Life Course

Table 4 shows that during the 9-year period after birth of the first child, among women with at least 1 subsequent child, nurse-visited women had longer intervals between the births of first and second children (40.73 vs 34.09 months; effect size [ES] 0.29; P .002) and had fewer cumulative subsequent births per year than did their control-group counterparts (0.81 vs 0.93; ES 0.14; P .045). Figure 1 shows the cumulative number of subsequent births per year by treatment assignment and women's psychological resources; it emphasizes that the treatment main effect on number of cumulative subsequent births was limited to women with initially high psychological resources (0.69 vs 0.91; ES 0.26; P .010; data not shown in Table 4),

TABLE 3 Background Characteristics of Participants on Whom 9-Year Assessments Were Completed

Background Variable	Treatment Group	
	Comparison (n 436)	Nurse-Visited (n 191)
Married, %		
Whole	1.4	0.5
Low-resource	0.4	1.0
Maternal race, nonblack, %		
Whole	5.7	7.9
Low-resource	4.8	6.8
Head of household employed, %		
Whole	56.8	50.0
Low-resource	52.4	50.0
Drank alcohol last 14 d, %		
Whole	4.4	4.2
Low-resource	5.7	5.8
Smoked cigarettes last 3 d, %		
Whole	8.3	9.4
Low-resource	8.3	10.7
Used marijuana last 14 d, %		
Whole	1.6	1.0
Low-resource	1.7	1.9
Any drug use (screen), %		
Whole	4.2	3.3
Low-resource	7.4	6.0
Any sexually transmitted disease, prerandomization, %		
Whole	33.6	37.2
Low-resource	32.8	40.8
Maternal age, mean (SD), y		
Whole	18.03 (3.19)	18.02 (3.30)
Low-resource	18.10 (3.28)	18.13 (3.86)
Gestational age at randomization, mean (SD), wk		
Whole	16.53 (5.74)	16.56 (5.58)
Low-resource	16.35 (5.83)	16.80 (5.50)
Psychological resources index, mean (SD)		
Whole	99.84 (9.95)	99.62 (10.81)
Low-resource	92.27 (5.77)	91.73 (6.77)
Highest grade completed, mother, mean (SD)		
Whole	10.24 (1.87)	10.06 (2.00)
Low-resource	9.91 (1.91)	9.54 (2.02)
Household poverty index, mean (SD)		
Whole	99.59 (10.05)	102.02 (9.96)
Low-resource	101.91 (10.08)	103.67 (9.59)
Neighborhood adversity index, mean (SD)		
Whole	3.22 (2.02)	3.35 (2.33)
Low-resource	3.36 (1.90)	3.23 (2.34)
Conflict with mother, mean (SD)		
Whole	99.80 (10.35)	100.46 (9.17)
Low-resource	101.79 (12.57)	101.31 (10.15)
Conflict with partner, mean (SD)		
Whole	99.73 (10.13)	100.62 (9.69)
Low-resource	100.93 (11.33)	102.36 (11.38)
Attitudes toward child rearing predictive of child abuse, mean (SD)		
Whole	99.55 (9.52)	101.04 (10.97)
Low-resource	102.47 (9.05)	104.82 (9.42)

^aAverage scores of women's sense of mastery/self-efficacy, mental health, and intellectual functioning.

^bStandardized to sample mean 100, SD 10.

^cAverage scores of household discretionary income, housing density, and whether head of household was employed.

^dAverage of variables calculated in SD units above the national means of components that comprise a standard neighborhood disorganization scale (eg, percentage of block group below the federal poverty level; percentage of families headed by single women; percentage of families receiving public assistance).

^eLocally developed scale that assesses the degree to which individual provides emotional and material support to mother.



averaging across the entire period after birth of the first

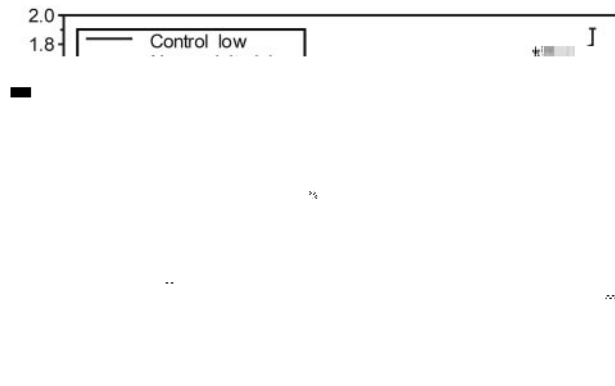


FIGURE 1 Program impact on number of subsequent children who were born to mothers with low psychological resources after birth of first child by maternal psychological resources.

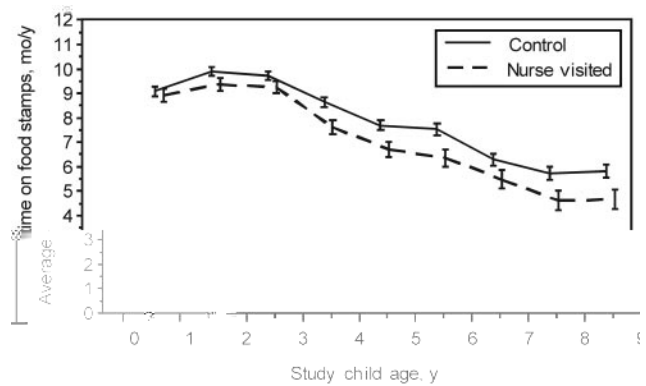


FIGURE 4 Program impact on use of food stamps (mean number of months per year) after birth of first child.

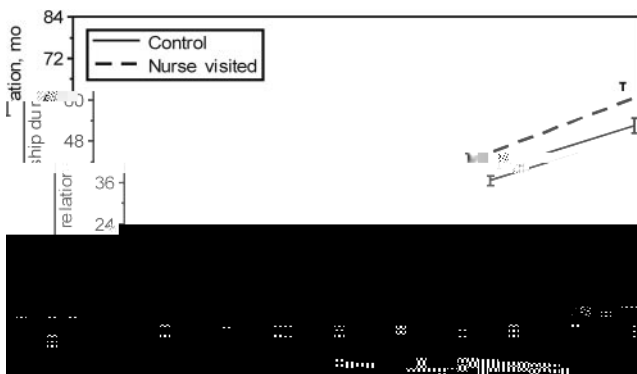


FIGURE 2 Program impact on duration of partner relations at 6 and 9 years after birth of first child.

for fewer months per year (5.21 vs 5.92 [ES 0.14; P .008] and 6.98 vs 7.80 months per year [ES 0.17; P .001], respectively). Figures 3 and 4 present the pattern of program effects on welfare and food stamp use during the 9-year period after birth of the first child. For the 6- to 9-year interval, the program effect on food stamps was significant (4.89 vs 5.92 months per year; ES 0.21; P .017), but the

effect on AFDC/TANF was not (3.39 vs 4.01 months per year; ES 0.12; P .117).

When examined during the entire 9-year period, nurse-visited women expressed greater mastery over the challenges in their lives (101.03 vs 99.50; ES 0.15; P .005). Figure 5 shows that this effect was concentrated during the period while the program was operating (through child age 2). By age 9, the treatment-control difference was no longer significant.

Nurse-visited mothers, as a trend, used fewer substances (the count of moderate-to-heavy alcohol use, marijuana, and cocaine: 0.10 vs 0.17; IR: 0.62, P .075). There were no statistically significant program effects on women's subsequent miscarriages, abortions, or stillbirths; arrests or being jailed; use of Medicaid; depression; employment; or marriage or being in a partnered relationship.

Child Outcomes

As shown in Table 2, nurse-visited children who were born to mothers with low psychological resources, compared with their control-group counterparts, had better GPAs averaged across reading and math (2.68 vs 2.44;

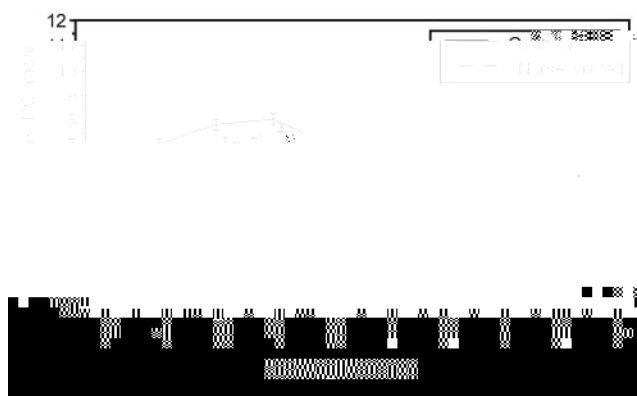


FIGURE 3 Program impact on use of AFDC/TANF (mean number of months per year) after birth of first child.

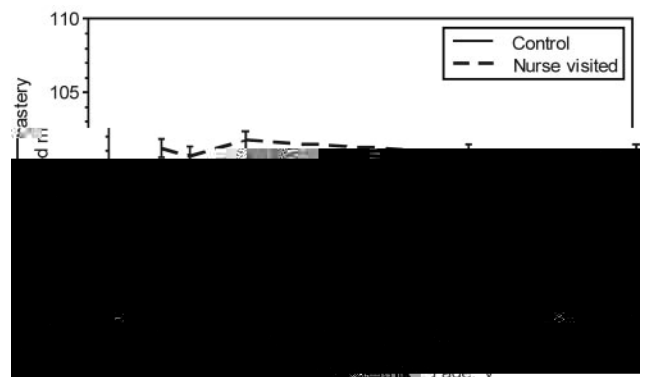


FIGURE 5 Program impact on maternal mastery over time.

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the wherewithal to envision and secure employment¹¹ and manage simultaneously the demands of being an employee and providing competent care for their children.⁸ One crucial factor contributing to economic self-sufficiency is pregnancy planning. The lower resource mothers who were visited by nurses, we hypothesize, had fewer personal resources to enable them to manage both roles well and therefore chose to focus their limited resources on the care of their children rather than attempting to make it in the world of work.

Without help, low-resource mothers are at greater risk for having difficulty caring competently for their children, who in turn are at risk for a host of problems. We believe that nurse-visited low-resource mothers chose to focus their resources on the care and protection of their children, and this explains why they were particularly successful, compared with their control-group counterparts, in managing the care of their firstborn children, as reflected in their children's having fewer injuries through age 2 and better cognition, arithmetic achievement, adjustment at age 6, and academic achievement in grades 1 to 3.^{7,8,11,12}

It is possible that the reduction in use of AFDC/TANF and food stamps observed during the 9-year period after birth of the first child for the entire sample may be explained at least in part by the nurse-visited women's increased involvement with the first child's biological father and the stability of partnered relationships, given that their partners were frequently employed and most likely brought additional financial resources to the household.

In 1996, the US welfare reform act went into effect,³¹ limiting women's lifetime use of public assistance (TANF). Although this may partially explain the gradually diminished impact of the program on use of welfare

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