

# Long-term Effects of Nurse Home Visitation on Children's Criminal and Antisocial Behavior

## 15-Year Follow-up of a Randomized Controlled Trial

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**Context.**—A program of home visitation by nurses has been shown to affect the rates of maternal welfare dependence, criminality, problems due to use of substances, and child abuse and neglect. However, the long-term effects of this program on children's antisocial behavior have not been examined.

**Objective.**—To examine the long-term effects of a program of prenatal and early childhood home visitation by nurses on children's antisocial behavior.

**Design.**—Fifteen-year follow-up of a randomized trial. Interviews were conducted with the adolescents and their biological mothers or custodial parents.

**Setting.**—Semirural community in New York.

**Participants.**—Between April 1978 and September 1980, 500 consecutive pregnant women with no previous live births were recruited, and 400 were enrolled. A total of 315 adolescent offspring participated in a follow-up study when they were 15 years old; 280 (89%) were born to white mothers, 195 (62%) to unmarried mothers, 151 (48%) to mothers younger than 19 years, and 186 (59%) to mothers from households of low socioeconomic status at the time of registration during pregnancy.

**Intervention.**—Families in the groups that received home visits had an average of 9 (range, 0-16) home visits during pregnancy and 23 (range, 0-59) home visits from birth through the child's second birthday. The control groups received standard prenatal and well-child care in a clinic.

**Main Outcome Measures.**—Children's self-reports of running away, arrests, convictions, being sentenced to youth corrections, initiation of sexual intercourse, number of sex partners, and use of illegal substances; school records of suspensions; teachers' reports of children's disruptive behavior in school; and parents' reports of the children's arrests and behavioral problems related to the children's use of alcohol and other drugs.

**Results.**—Adolescents born to women who received nurse visits during pregnancy and postnatally and who were unmarried and from households of low socioeconomic status (risk factors for antisocial behavior), in contrast with those in the comparison groups, reported fewer instances (incidence) of running away (0.24 vs 0.60;  $P = .003$ ), fewer arrests (0.20 vs 0.45;  $P = .03$ ), fewer convictions and violations of probation (0.09 vs 0.47;  $P < .001$ ), fewer lifetime sex partners (0.92 vs 2.48;  $P = .003$ ), fewer cigarettes smoked per day (1.50 vs 2.50;  $P = .10$ ), and fewer days having consumed alcohol in the last 6 months (1.09 vs 2.49;  $P = .03$ ). Parents of nurse-visited children reported that their children had fewer behavioral problems related to use of alcohol and other drugs (0.15 vs 0.34;  $P = .08$ ). There were no program effects on other behavioral problems.

**Conclusions.**—This program of prenatal and early childhood home visitation by nurses can reduce reported serious antisocial behavior and emergent use of substances on the part of adolescents born into high-risk families.

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JUVENILE CRIME is a significant problem in the United States. In 1996, law enforcement agencies made 2.9 million arrests of juveniles (children <18 years). Moreover, 19% of all arrests and 19% of all violent crime arrests were accounted for by juveniles. Although the number of juvenile Violent Crime Index arrests (ie, for murder, forcible rape, robbery, and aggravated assault) declined in both 1995 and 1996, the rate in 1996 was still 60% higher than the 1987 level.<sup>1</sup>

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For editorial comment see p 1271.

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Antisocial behavior can be classified according to its time of onset: prior to puberty (childhood onset) vs after puberty (adolescent onset).<sup>2,3</sup> Childhood onset is characterized by more serious behavioral disruption, such as violent behavior toward classmates and cruelty toward animals beginning as early as age 3 years, but occurs less frequently. The adolescent-onset variety, although sometimes expressed as aggression toward peers, is generally less serious (eg, shoplifting, lying to teachers and parents) and occurs so frequently that some consider it normative.<sup>3</sup> Childhood-onset antisocial behavior is associated with neuropsychological deficits (eg, impaired language and intellectual functioning, attention-deficit/hyperactivity disorder) and harsh, rejecting parenting early in the child's life.<sup>4,5</sup> The

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Table 1.—Flow of Patients From Recruitment During Pregnancy Until 15 Years After Delivery of First Child

	Treatment Groups*		
	1 and 2 (n = 184)	3 (n = 100)	4 (n = 116)
Program implementation			
No. of completed prenatal home visits, average (range)	...†	8.6 (0-16)	8.6 (0-16)
No. of completed postnatal home visits, average (range)	...	...	22.8 (0-59)
Intervening years			
No. of fetal, infant, or child deaths	10	7	9
No. of children adopted‡	7	6	2
No. of maternal deaths§	1	1	0
15-Year follow-up study			
No. of missing biological mothers	12	1	4
No. who refused to participate			
Mothers	6	5	4
Adolescents	10	8	7
No. of completed interviews			
Parents (biological or custodial)	152	81	97
Adolescents	144	77	94
No. of cases with school data (grades 7-9)	139	68	84
No. of cases with teacher report data¶	117	66	79
No. of cases with probation or family court data#	60	27	29

\*Treatment groups 1 and 2 are the comparison; treatment group 3 was nurse-visited during pregnancy; and treatment group 4 was nurse-visited during pregnancy and infancy. Of 500 eligible persons invited to participate, 100 refused and 400 were randomized to the various treatment groups.

†Ellipses indicate data not available.

‡There were 2 adoptions in which interviews were conducted with the child but not the mother. They are not shown.

§For both cases in which the mother died, the adolescents were interviewed.

||Refusals include 8 mothers who refused to participate during earlier phases and were not approached for the 15-year follow-up.

¶Data are for cases with at least 1 mathematics or English teacher report of classroom behavior.

#Data are for subsample of children who resided in original community for their entire lives.

adolescent-onset type has been hypothesized to be a reaction to the limited number of responsible roles for adolescents in Western societies.<sup>3</sup>

In earlier articles, we have shown that a program of prenatal and infancy home visitation by nurses improved women's prenatal health-related behavior<sup>6</sup> and reduced the rates of child abuse and neglect,<sup>7,8</sup> maternal welfare dependence, closely spaced successive pregnancies, maternal criminal behavior and behavioral problems due to use of alcohol and other drugs,<sup>9</sup> and children's intellectual impairment associated with prenatal exposure to tobacco.<sup>9,10</sup> These aspects of maternal and child functioning represent significant risks for early-onset antisocial behavior.<sup>11</sup>

This article examines the extent to which this program produced a reduction in children's criminal and antisocial behavior. We expected that the program would reduce antisocial behaviors indicative of the early-onset type but did not expect it to have as dramatic an effect on adolescent-onset antisocial behavior.<sup>11</sup> We expected that program effects would be concentrated on children born to women who were unmarried and from low-income families at registration during pregnancy. One of the treatment conditions used in this study consisted of prenatal home visitation with no postpartum follow-up. We expected that the group receiving only prenatal home visitation would function better than the

comparison group but not as well as the group that received prenatal and postnatal home visitation.

## METHODS

The details of this study's design can be found in an earlier article.<sup>8</sup> A summary of the design is given herein.

### Setting, Participants, and Randomization

Pregnant women were recruited from a free antepartum clinic sponsored by the Chemung County, New York, health department and the offices of private obstetricians in Elmira, NY. We actively recruited women with no previous live births who were less than 25 weeks pregnant and who were young (aged <19 years at registration), unmarried, or of low socioeconomic status (SES). Women without these sociodemographic risk characteristics were permitted to enroll if they had no previous live births. From April 1978 through September 1980, 500 women were invited to participate and 400 enrolled. Eighty-five percent were young, unmarried, or from low-SES households (August Hollingshead, PhD, unpublished manuscript, 1976). After completing informed consent and baseline interviews, women were stratified by sociodemographic characteristics and randomized to 1 of 4 treatment conditions. Persons involved in data gathering were blinded to the women's treatment conditions.

## Treatment Conditions

Families in treatment group 1 (n = 94) were provided sensory and developmental screening for the child at 12 and 24 months of age. Based on these screenings, the children were referred for further clinical evaluation and treatment when needed. Families in treatment group 2 (n = 90) were provided the screening services offered those in treatment group 1 in addition to free transportation (using a taxicab voucher system) for prenatal and well-child care through the child's second birthday. There were no differences between treatment groups 1 and 2 in their use of prenatal and well-child care (both groups had high rates of completed appointments). Therefore, these 2 groups were combined to form a single comparison group as in earlier articles. Families in treatment group 3 (n = 100) were provided the screening and transportation services offered to treatment group 2 and in addition were provided a nurse who visited them at home during pregnancy. Families in treatment group 4 (n = 116) were provided the same services as those in treatment group 3 except that the nurse continued to visit through the child's second birthday.

## Program Plan and Implementation

In the home visits, the nurses promoted 3 aspects of maternal functioning: (1) positive health-related behaviors during pregnancy and the early years of the child's life, (2) competent care of their children, and (3) maternal personal development (family planning, educational achievement, and participation in the workforce). In the service of these 3 goals, the nurses linked families with needed health care and human services and attempted to involve other family members and friends in the pregnancy, birth, and early care of the child. The nurses completed an average of 9 visits during pregnancy (range, 0-16) and 23 visits from birth to the child's second birthday (range, 0-59). Details of the program can be found elsewhere.<sup>12,13</sup>

## Overview of Follow-up Study

The current phase of the study consists of a longitudinal follow-up of the 400 families who were randomized to treatment and control conditions and in which the mother and child were still alive and the family had not refused participation at earlier phases. The flow of patients from recruitment through the 15-year follow-up is presented in Table 1. Interviews were conducted with the adolescents, their biological mothers, and their custodial parents if the biological mother no longer had custody. As-

assessments using parent reports used interview data from the parent who was judged to have had the greatest amount of recent experience with the child.

### Assessments and Definitions of Variables

Assessments conducted at earlier phases are specified in previous articles.<sup>7,8</sup> At the 15-year follow-up assessment, adolescents completed interviews that measured whether they had been adjudicated a person in need of supervision (PINS) resulting from incorrigible behavior such as recurrent truancy or destroying parents' property; their frequency of running away from home; and the number of times they had been stopped by the police, arrested, convicted of a crime or of probation violations, and sent to youth correctional facilities.<sup>14</sup> They also reported on their disruptive behavior in school; number of school suspensions; delinquent and aggressive behavior outside school; experience of sexual intercourse; rates of pregnancy; lifetime number of sexual partners; and frequency of using cigarettes, alcohol, and illegal drugs during the 6-month period prior to the 15-year interview.<sup>15</sup>

Variables were created to summarize the number of occurrences of being stopped by the police, arrested, convicted (adjudicated) of the original crime or of probation violations, and sent to a youth correctional facility. Although we asked the children to report their number of school suspensions and disruptive behaviors in school, we used archived school data and teacher reports to measure these outcomes because they are less subject to reporting bias than are self-report data.

A variable was constructed to characterize the total number of cigarettes currently smoked per day. Separate variables were constructed to count the number of days the children had consumed alcohol or used illegal drugs during the 6-month period prior to the interview. The adolescents were asked questions regarding the effect of alcohol on 5 domains of their lives (trouble with parents, trouble at school, problems with friends, problems with someone they were dating, trouble with police).<sup>16</sup> These data were summarized in an alcohol-use behavioral problem scale (range, 0-5). Corresponding questions regarding use of illegal drugs were omitted because of clerical error.

The self-reports of antisocial and delinquent acts were factor analyzed and found to produce 2 factors, major delinquent acts and minor antisocial acts, with Cronbach  $\alpha$  coefficients of .82 and .68, respectively. The adolescents also completed the Achenbach Youth Self-Report of Problem Behaviors, which produces 2 broadband scales: internalizing

(anxiety/depression, social withdrawal, and somatic complaints) and externalizing (delinquency and aggression) behavior problems.<sup>17</sup>

Parents were asked questions about their children's behavioral problems (the Achenbach scale); school suspensions; arrests; and use of cigarettes, alcohol, and illegal drugs, including the effect of alcohol and other drugs on their children's lives. Variables were constructed to coincide with those based on the child's self-report of behavior. Parents' reports of their children's behavioral problems caused by substance use included children's use of illegal drugs (range, 0-10).

The number of short-term and long-term suspensions were counted from an abstraction of the children's school records for grades 7 through 9. In New York State, long-term suspensions require a hearing and usually are for serious infractions such as assaulting a student or teacher. Records were analyzed when there were complete school data for 2 of the 3 years. The students' current teachers in English and mathematics completed an "acting out" scale that rated children's disruptive behavior in the classroom (eg, disruptive in class, defiant, obstinate, stubborn).<sup>18</sup>

Finally, the records of 116 children who lived in Chemung County for their entire lives were reviewed by the Chemung County Probation Department and the Chemung County Family Court. Identifying information on the adolescents (name, birth date, sex, Social Security number) was provided to these departments for purposes of matching their records with the participants in this study. The department staff summarized the counts of arrest and PINS records within treatment and risk-status groups. Individual identifiers were not returned in the abstraction of these data, although the children's treatment group, sex, and risk status (ie, whether they were born to an unmarried mother from low SES) were returned.

### Statistical Models and Methods

The study was conducted with an intention-to-treat approach. A core statistical model was derived that was consistent with the one used in the earlier phases of this research. It consisted of a  $3 \times 2 \times 2 \times 2$  factorial structure and 6 covariates. The classification factors were treatment groups (1 and 2 vs 3 vs 4), maternal marital status (married vs unmarried at registration), social class (Hollingshead I and II vs III and IV at registration), and sex of child. All interactions among the first 3 factors were included.

Interactions with sex of the child also were examined. Although sex was a sig-

nificant predictor of the antisocial behavior outcomes, it did not interact in a fully interpretable way with other terms in the model for some outcomes, so it was included without interactions. Where program effects were moderated by the child's sex in a coherent way, we have noted this in the presentation of the findings, in which case the model includes SES as a covariate rather than a classification factor and includes all interactions among treatment, marital status, and sex. This model was preferable to a 4-factor classification structure with all interactions because of the low incidence of some outcomes for certain subclasses, compromising the stability of the Poisson log-linear models used in the analysis. In addition, for 2 variables, the core log-linear model produced unstable variance estimates for the tests of treatment main effects. In these cases, SES and marital status were included without interactions for that test.

Race of the mother was among a number of additional classification factors examined in deriving the core model but was not included because it was not a significant predictor of outcomes once other terms were included.

The 6 covariates included in the final models were maternal age, maternal education, locus of control,<sup>18</sup> support from husband or boyfriend, maternal employment status, and paternal public assistance status. All covariates were measured at registration and tested for homogeneity of regressions for the hypothesized contrasts.<sup>19</sup>

Dependent variables with normal distributions were analyzed in the general linear model and low-frequency count data (eg, number of arrests) in the log-linear model (assuming a Poisson distribution). In the log-linear model, the analysis was carried out and estimates were obtained in terms of the logs of the incidence. We use the term *incidence* to refer to the actual count or mean of counts during specific periods of measurement. A careful examination of the distributions of each of the dependent variables was carried out. Low-incidence count variables with values higher than 20 were analyzed in a log-linear model, correcting for overdispersion.

For outcomes reported by more than 1 respondent (eg, child and parent or teachers), we carried out repeated-measures analyses, adding to the basic model fixed factors for respondent and a random factor for individuals. The focus of interpretation was on the average of the 2 sources of information.

All treatment contrasts focused on the comparison of the combination of treatment groups 1 and 2 (the comparison group) with treatment group 4 (the pregnancy and infancy nurse-visited group)

Table 2.—Equivalence of Treatment Conditions on Maternal Background Characteristics Measured at Registration for Children Assessed at 15-Year Follow-up\*

Dependent Variables	Total Sample of Treatment Groups			Low SES, Unmarried Sample of Treatment Groups		
	1 and 2 (n = 148)	3 (n = 79)	4 (n = 97)	1 and 2 (n = 62)	3 (n = 30)	4 (n = 38)
Unmarried, %	62	59	64	100	100	100
Low-SES household, %	64	70	61	100	100	100
White, %	90	91	86	87	87	77
Smoker (>4 cigarettes/day)	47	46	58	51	60	59
Male children, %	55	44	55	44	53	49
Mother working, %	39	36	31	24	20	20
Mother receiving public assistance, %	9	10	13	23	29	20
Father working, %	70	70	67	42	50	52
Father receiving public assistance, %	4	3	3	10	6	2
Husband or boyfriend in house, %	58	76	60	21	47	22
Maternal age, mean (SD), y	19.3 (2.9)	19.5 (3.1)	19.4 (3.7)	18.6 (2.5)	19.0 (2.8)	18.2 (3.3)
Maternal education, mean (SD), y completed	11.2 (1.5)	11.6 (1.5)	11.1 (1.6)	10.7 (1.4)	10.9 (1.4)	10.3 (1.5)
Husband or boyfriend education completed, mean (SD), y	11.4 (1.4)	11.7 (1.7)	11.5 (1.6)	11.1 (1.4)	11.0 (1.8)	10.8 (1.5)
Grandmother support, mean (SD)†‡	100.4 (10.1)	97.7 (9.2)	101.3 (10.3)	101.6 (10.9)	98.1 (10.3)	104.1 (11.2)
Husband or boyfriend support†‡	99.6 (10.5)	102.0 (9.0)	99.0 (9.9)	94.2 (10.6)	98.6 (9.4)	96.8 (9.3)
Locus of control, mean (SD)†	99.3 (10.1)	100.6 (9.5)	100.6 (10.2)	97.5 (10.2)	99.2 (10.3)	99.1 (9.9)
Incidence of maternal arrests in New York State prior to randomization§	0.09	0.13	0.06	0.13	0.13	0.18

\*Treatment groups 1 and 2 are the comparison; treatment group 3 was nurse-visited during pregnancy; and treatment group 4 was nurse-visited during pregnancy and infancy. SES indicates socioeconomic status.

†Standardized to mean (100) and SD (10).

‡Locally developed scale that assesses degree to which individual provides emotional and material support to mother.

§Incidence indicates the mean number of infrequently occurring events within the stated period. Individual cases may have values greater than 1.

because we hypothesized that the greatest treatment effect would be exerted by the combination of prenatal and postnatal home visitation, as found in earlier evaluations.<sup>7,8</sup> The results for the group that received prenatal home visitation only (treatment group 3) are included to report whether that group had intermediate levels of functioning. To address our primary hypotheses, treatment effects also are shown for adolescents whose mothers were unmarried and from low-SES households at registration during pregnancy. All estimates of treatment main effects and effects for the unmarried, low-SES group are derived from a common statistical model.

## RESULTS

### Equivalence of Treatment Groups on Background Characteristics

As indicated in Table 2, for those families for which 15-year assessments were completed, the treatment groups were essentially equivalent on background characteristics for both the sample as a whole and for women who were unmarried and from low-SES households. Small differences on some background variables (such as paternal receipt of public assistance) led us to include them as covariates.

### Encounters With the Criminal Justice System

Table 3 shows that adolescents born to nurse-visited women (treatment group 4) reported more frequent stops by police

( $P < .001$ ) but fewer arrests and convictions and violations of probation ( $P = .005$  and  $.001$ , respectively); the arrest and convictions and probation violation effects were concentrated among children born to women who were unmarried and from low-SES families ( $P = .03$  and  $< .001$ , respectively). For the subsample of children who lived in Chemung County for their entire lives, nurse-visited children (treatment group 4) had fewer official PINS records ( $P = .007$ ). Nurse-visited children whose mothers were unmarried and from low-SES families were reported by their parents to have been arrested less frequently than were their counterparts in the comparison group ( $P = .05$ ). In addition, among adolescents born to unmarried women from low-SES households, those in treatment group 4 reported fewer instances of running away ( $P = .003$ ). As indicated in Table 3, with the exception of parent report of child arrests, most of these effects were present for children whose mothers were visited only during pregnancy (treatment group 3).

The effect of the treatment group 4 program on the children's reports of running away was concentrated in girls, whereas the effect on parents' reports of the children's arrests and children's reports of convictions and probation violations was greater for boys (data not shown). The effect of the program on arrests was not limited to any specific type of crime, although property crimes were more frequent and, therefore, accounted for a larger portion of the program effect on arrests overall.

### School Suspensions, Behavior Problems, and Use of Substances

Table 4 shows that children born to nurse-visited (treatment group 4) women who were unmarried and from low-SES households reported having fewer sexual partners ( $P = .003$ ), smoking fewer cigarettes per day ( $P = .10$ ), and consuming alcohol fewer days during the 6-month period prior to the 15-year interview ( $P = .03$ ). Parents of children born to nurse-visited, unmarried women from low-SES families reported that their children had fewer behavioral problems related to their use of alcohol and other drugs ( $P = .08$ ). For these outcomes, there was some indication that the group visited by nurses only during pregnancy (treatment group 3) did not do as well. Although adolescents in the unmarried, low-SES group reported smoking fewer cigarettes, they also reported higher levels of illegal drug use and their parents reported more behavioral problems due to the use of alcohol and other drugs than did their counterparts in the comparison group. There were no treatment differences in teachers' reports of the adolescents' acting out in school; short-term or long-term suspensions; the adolescents' initiation of sexual intercourse; or the parents' or children's reports of major delinquent acts, minor antisocial acts, or other behavioral problems.

### COMMENT

Adolescents born to nurse-visited (treatment group 4) women who were un-

Table 3.—Adjusted Rates of Children's Encounters With Criminal Justice System From Birth to 15 Years of Age\*

Dependent Variables	Total Sample					Low-SES, Unmarried Sample				
	Treatment Group			P Value†		Treatment Group			P Value†	
	1 and 2	3	4	T1 & T2 vs T3	T1 & T2 vs T4	1 and 2	3	4	T1 & T2 vs T3	T1 & T2 vs T4
Ever PINS, %	13	11	8	.75	.33	14	10	5	.63	.14
Incidence of times ran away‡	0.29	0.23	0.34	.83	.07	0.60	0.14	0.24	<.002	.003
Incidence of times stopped by police	0.80	0.53	2.25	.24	<.001	1.16	0.78	1.46	.34	.46
Incidence of arrests	0.36	0.16	0.17	.005§	.005§	0.45	0.15	0.20	.02	.03
Incidence of convictions and probation violations	0.27	0.06	0.10	<.001§	<.001§	0.47	0.07	0.09	<.001	<.001
Incidence of times sent to youth corrections	0.05	0.05	0.04	.98	.98	0.06	0.03	0.02	.32	.12
Incidence of arrests (mother report)	0.12	0.11	0.08	.73	.37	0.19	0.16	0.04	.79	.05
Incidence of PINS records (subsample, archived data)	0.31	0.17	0.03	.06	.007	0.35	0.33	0.00	.94	.07
Incidence of arrests (subsample, archived data)	0.35	0.14	0.32	.15	.94	0.55	0.22	0.44	.24	.74

\*Treatment group 1 and 2 (T1 and T2) are the comparison; treatment group 3 (T3) was nurse-visited during pregnancy; and treatment group 4 (T4) was nurse-visited during pregnancy and infancy. Data are adjusted for socioeconomic status (SES), maternal marital status, age, education, locus of control, support from husband or boyfriend, and working status; husband or boyfriend use of public assistance at registration; and sex of child. PINS indicates person in need of supervision.

†Test of treatment effect performed on odds ratios for percentage outcomes and difference of logs of incidence for incidence outcomes.

‡Incidence indicates the mean number of infrequently occurring events within the stated period. Individual cases may have values greater than 1.

§Test conducted without interactions for SES and marital status.

||No covariates were included in the analysis of this outcome.

Table 4.—Adjusted Reports of Problem Behavior, Sexual Activity, Pregnancy, and Use of Substances at 15-Year Follow-up\*

Dependent Variables	Total Sample					Low-SES, Unmarried Sample				
	Treatment Groups			P Value†		Treatment Groups			P Value†	
	1 and 2	3	4	T1 & T2 vs T3	T1 & T2 vs T4	1 and 2	3	4	T1 & T2 vs T3	T1 & T2 vs T4
No. of minor antisocial acts, mean‡	2.99	2.54	2.88	.50	.86	4.06	3.25	3.38	.42	.47
No. of major delinquent acts, mean§	3.02	2.79	3.57	.93	.48	4.09	3.45	3.99	.60	.77
No. of externalizing problems, mean	13.73	13.65	13.88	.95	.89	14.18	15.63	11.85	.42	.17
No. of internalizing problems, mean	10.58	11.19	11.66	.46	.19	10.82	11.15	9.85	.80	.44
No. of acting out problems, mean¶	9.61	8.97	9.47	.41	.85	10.36	9.79	10.58	.62	.85
Ever had sexual intercourse, %	35	35	42	1.00	.32	45	55	46	.44	1.00
Ever pregnant or made someone pregnant, %	3	2	4	.97	1.00	8	9	7	.90	.74
Incidence of sex partners#	1.56	1.10	1.16	.48	.90	2.48	2.23	0.92	.73	.003
Incidence of short-term school suspensions	0.28	0.11	0.27	.96	.97	0.32	0.16	0.38	.11	.63
Incidence of long-term school suspensions	0.04	0.00	0.01	1.00	1.00	0.15	0.01	0.04	.97	.25
Incidence of cigarettes smoked per day	1.30	0.91	1.28	.49	.76	2.50	1.32	1.50	.07	.10
Incidence of days drank alcohol	1.57	1.81	1.87	.97	.96	2.49	1.84	1.09	.41	.03
Incidence of days used drugs	2.28	3.55	2.04	.49	.54	4.04	9.38	2.50	.01	.24
Alcohol impairment, self-report	0.52	0.50	0.47	.95	.35	0.49	0.38	0.55	.36	.60
Alcohol and drug impairment, parent's report	0.18	0.20	0.28	.96	.68	0.34	0.62	0.15	.05	.08

\*Treatment groups 1 and 2 (T1 and T2) are the comparison; treatment group 3 (T3) was nurse-visited during pregnancy; and treatment group 4 (T4) was nurse-visited during pregnancy and infancy. Data are adjusted for maternal socioeconomic status, marital status, education, locus of control, support from husband/boyfriend, and working status; husband/boyfriend use of public assistance at registration; and sex of child.

†Test of treatment effect based on mean differences for means, odds ratios for percentages, and difference of logs of incidence for count data outcomes.

‡Minor antisocial acts included lied to parents, lied to teacher, took car without permission, stayed out all night without permission, been passenger in car where driven drunk, and used fake identification to enter bar.

§Major delinquent acts included hurt someone who needed bandages, stole something worth more than \$50, stole something worth less than \$50, trespassed, damaged property on purpose, hit someone because did not like what he or she said, carried weapon, set fire on purpose, and been in fight with gang members.

||Average of parent and child reports of behavioral problem (analyzed with repeated measures).

¶Average of mathematics and English teachers' reports of students' disruptive behavior in school (analyzed with repeated measures).

#Incidence indicates mean number of infrequently occurring events within the stated period. Individual cases may have values greater than 1.

married and from low-SES families had fewer episodes of running away from home, arrests, and convictions and violations of probation than did their counterparts in the comparison group. They also had fewer sexual partners and engaged in cigarette smoking and alcohol consumption less frequently. Their parents reported that they had fewer behavioral problems related to their use of drugs and alcohol. There were no program effects on less serious forms of antisocial behavior, initiation of sexual intercourse, or use of

illegal drugs. Children in treatment group 4, irrespective of risk, reported being stopped by police more frequently, but they reported fewer arrests and convictions and violations of probation, and the official PINS records corroborated this pattern. The higher rates of being stopped by police is an anomalous finding that has no coherence with any other effects and is likely to be either a sampling or reporting artifact.

The concentration of beneficial effects among children born to unmarried wom-

en of low SES is consistent with the results of other preventive interventions that have shown greater effects for children of families at greater social risk.<sup>20</sup> This suggests that these kinds of services ought to be focused on families in greater need by virtue of the mothers' being unmarried and poor.

In general, these findings are consistent with program effects on early-onset antisocial behavior rather than on the more common and less serious antisocial behavior that emerges with puberty.<sup>3</sup>

The mere presence of arrests, convictions, and probation violations by the time the children were 15 years old suggests that these children started offending early and that they may be on life-course trajectories that portend recurrent and more serious offenses in the future. Given that early-onset antisocial behavior is associated with (1) subtle neurological impairment, (2) harsh, punitive, and neglectful parenting, and (3) family contexts characterized by substance abuse and criminal behavior,<sup>2-5</sup> it is important to note that this program has affected these aspects of maternal, child, and family functioning at earlier phases in the child's development.<sup>6-11</sup> Moreover, genetic vulnerability to impulsivity and aggression is expressed much more frequently when vulnerable rhesus monkeys experience aberrant rearing<sup>21</sup> (also Allyson J. Bennett, PhD, K. Peter Lesch, Armin Heils, et al, unpublished data, 1998), adding to the plausibility of the findings reported here.

The prenatal phase of the program reduced fetal exposure to tobacco, improved the qualities of women's prenatal diets, reduced rates of pyelonephritis, improved levels of informal social support, and reduced intellectual impairment and irritable behavioral styles associated with fetal exposure to tobacco.<sup>6,10,11,22</sup> Prenatal exposure to tobacco is a risk factor for early behavioral dysregulation, problems with attention, and later crime and delinquency.<sup>22</sup> Moreover, the combination of birth complications (and, by implication, neurological impairment) and rejecting parenting substantially increases the likelihood of violent offenses by the time children are 18 years old.<sup>5</sup>

We did not expect prenatal home visitation (treatment group 3) by itself to be as effective as it was in preventing criminal behavior among children born to low-SES, unmarried women. This occurred even though these children's mothers showed almost none of the postnatal benefits observed for those visited during pregnancy and infancy (such as reduced welfare dependence, substance abuse, criminal behavior, and child abuse and neglect).<sup>8</sup> The mechanisms through which these beneficial effects occurred will be examined in future reports, with a focus on the alteration of maternal prenatal health and the children's corresponding neuropsychological functioning,<sup>22,23</sup> as well as prenatal stress, given that stress during pregnancy affects the social and neuromotor development of nonhuman primates.<sup>24,25</sup>

The impact of the full program (prenatal and infancy home visitation) on children's use of alcohol and number of sexual partners is important because re-

cent evidence indicates that alcohol use prior to age 15 years multiplies the risk of alcoholism in adulthood<sup>26</sup> and multiple partners increase the risk for sexually transmitted diseases, including human immunodeficiency virus infection.<sup>27,28</sup> The effect of the program on alcohol use is consistent with greater alcohol consumption observed among adult rhesus monkeys who experienced aberrant rearing.<sup>29</sup> These findings must be tempered, however, with an acknowledgment of their limitations.

The first limitation is that most of the positive results were concentrated among children born to women who were unmarried and from low-SES households. Although we hypothesized originally that the effects would be greater for women who experienced higher levels of stress and who had fewer personal resources, we did not fully operationalize the stress and resource variables prior to the beginning of the trial. We chose to use characteristics used for sample recruitment as indicators of long-term stress (eg, coming from a low-SES household) and having few personal resources (eg, being unmarried), 2 factors associated with a host of adverse outcomes. However, positive early results from a large urban replication of this study focusing almost exclusively on unmarried, low-income women support our interpretation that the effects observed in the current study are due to the program.<sup>30</sup>

The second limitation is that the arrest and conviction data were based primarily on the children's and parents' reports, which may be subject to treatment-related reporting bias. To validate the children's and parents' reports of undesirable behavior, we compared the rates of school suspensions derived from the school records with the parents' and children's reports of suspensions and found no treatment differences in accuracy. We also regressed the English and mathematics teachers' averaged reports of the adolescents' acting out in school on the adolescents' self-reports of their acting out in school separately for the nurse-visited and comparison group children and found no treatment differences in the slopes of these regressions.

Importantly, the pattern of mean differences for treatment groups 1 and 2 vs treatment group 4 for PINS records on the subsample of children who lived in Chemung County for their entire lives corroborated the pattern of the children's reported arrests. The PINS finding increases our confidence that the treatment differences in the adolescents' reported involvement with the criminal justice system are not the result of the nurse-visited children and their parents simply underreporting their actual lev-

els of involvement. The absence of program effect with the official arrest data may be explained by a significant, 9-fold higher rate of official arrest records prior to randomization (0.44 vs 0.05) found for treatment group 4 mothers who were unmarried and of low SES and whose children remained in Chemung County compared with their treatment group 1 and 2 counterparts.

Finally, we note that the adolescents' self-reports of delinquent and antisocial behavior are not completely consistent with the data on reports of arrests and convictions. A survey that used follow-up questions to the assault questions asked in the current study showed that the answers to the questions we used produced responses that frequently were trivial (eg, 33% of the serious violent responses and 64% of the self-reported minor assaults were too insignificant to lead to arrests).<sup>31</sup> This suggests that the particular questions used in this study regarding delinquent behavior did not adequately assess the severity of delinquency. Thus, the treatment differences found in reports of arrests and convictions are likely to be indications of underlying treatment differences in the severity of antisocial behavior that were not assessed adequately by the set of questions asked about particular antisocial behaviors.

This program prevented only the more serious forms of antisocial behavior leading to arrests and convictions. Other types of prevention programs may be necessary to reduce more normative types of disruptive behavior among young adolescents.<sup>32</sup> In light of the impact of this program on maternal and youth crime and corresponding government expenditures,<sup>8,33</sup> the US Department of Justice is now supporting an effort to make this program available to a larger number of high-crime communities.<sup>34</sup>

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