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Complete List of Authors:	Olds, David; University of Colorado at Denver - Anschutz Medical Campus, Department of Pediatrics Kitzman, Harriet; University of Rochester, School of Nursing Knudtson, Michael; University of Colorado at Denver - Anschutz Medical Campus, Department of Pediatrics Cole, Robert; Community Health Strategies, N/A Anson, Elizabeth; University of Rochester, School of Nursing Smith, Joyce; University of Rochester, School of Nursing Fishbein, Diana; Pennsylvania State University, Human Development and Family Studies DiClemente, Ralph; New York University, Social and Behavioral Sciences Wingood, Gina; Columbia University, Sociomedical Sciences Caliendo, Angela; Brown University, Alpert Medical Hopfer, Christian; University of Colorado at Denver - Anschutz Medical Campus, Psychiatry Miller, Ted; PIRE, none; Conti, Gabriella; University College London, Economics and Department of Social Science
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Prenatal/Infancy Nurse Home Visiting and 18-Year Outcomes of a Randomized Trial

Harriet Kitzman, Ph.D. [a], David L. Olds, Ph.D. [b], Michael D. Knudtson, M.S. [b], Robert Cole, Ph.D. [a], Elizabeth Anson, M.S. [a], Joyce A. Smith, R.N., Ph.D.[a], Diana Fishbein, Ph.D. [c], Ralph DiClemente, Ph.D.[d], Gina Wingood, Ph.D.[e], Angela M. Caliendo, MD. PhD. [f], Christian Hopfer, M.D.[g], Ted Miller, Ph.D.[h], Gabriella Conti, Ph.D. [i]

Affiliations: [a] University of Rochester School of Nursing; [b] University of Colorado Department of Pediatrics; [c] Edna Bennett Pierce Prevention Research Center, Pennsylvania State University; [d] New York University, College of Global Public Health; [e] Columbia University, Mailman School of Public Health; [f] Alpert Medical of Brown University; [g] University of Colorado Department of Psychiatry; [h] Pacific Institute for Research and Evaluation and Curtin University; and [i] University College London

Address Correspondence to: David L. Olds, Ph.D., University of Colorado Denver, 13121 E. 17th Ave, MS 8410, Aurora, CO 80045, phone: 303-724-2892; fax: 303-724-290, e-mail: David.Olds@UCDenver.edu

Short Title: 18-Year Effect of Prenatal/Infancy Nurse Home Visiting

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Data Sharing Statement:
De-identified individual participant data (including data dictionaries) will be made available, in addition to study protocols, the statistical analysis plan, and the informed consent form. The data will be made available upon publication to researchers who provide a methodologically sound proposal for use in achieving the goals of the approved proposal. Please contact Michael Knudtson, the study biostatistician, at Michael.knudtson@ucdenver.edu 303-724-3199 for further details.

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Potential Conflict of Interest: The Prevention Research Center for Family and Child Health (PRC), directed by DLO at the University of Colorado School of Medicine, has a contract with the Nurse-Family Partnership© to conduct research to improve the NFP program and its implementation; this contract covers part of Dr. Olds's salary and part of Michael Knudtson's salary. Dr. Olds and Mr. Knudtson were employed by this center at the time the study was conducted. Dr. Olds is the founder of the NFP and with the University of Colorado owns the NFP intellectual property. The University of Colorado receives royalties from governments and organizations outside of the US that implement the NFP and has contracts with those entities to guide implementation of the NFP with quality, but none of the royalties or fees go to Dr. Olds personally; they are used to support PRC research and implementation guidance. Dr. Miller

performs economic analyses under contract for the non-profit Nurse-Family Partnership National Service Office. The remaining authors have indicated they have no potential conflicts of interest to disclose.

Abbreviations:

CBCL	Child Behavior Check List
CDMT	Cambridge Decision Making Task
CIDI-SAM	Composite International Disease Interview – Substance Abuse Module
HIV	Human Immunodeficiency Virus
IQ	Intelligence Quotient
KBIT–2	Kaufman Brief Intelligence Test
LPR	Limited Psychological Resources
NFP	Nurse-Family Partnership
NV	Nurse-Visited
PIAT	Peabody Individual Achievement Test
PPVT	Peabody Picture Vocabulary Test
PCP	Phencyclidine
PR	Psychological Resources
RCTs	Randomized Clinical Trials
STI	Sexually Transmitted Infection
SSI	Supplemental Security Income
TN	Tennessee
THC	Tetrahydrocannabinol
WAIS	Wechsler Adult Intelligence Scale
YSR	Youth Self-Report

Table of Contents Summary: This study summarizes effects of prenatal and infancy home visits on youth cognition and behavior found in an 18-year follow-up of a randomized clinical trial.

What's Known on this Subject: Two randomized trials of prenatal and infant home visiting by nurses found effects on children's behavioral problems, early adolescent substance use, and, among children born to mothers with limited psychological resources, cognitive outcomes. One trial found fewer convictions among females.

What This Study Adds: This trial extends earlier estimates of intervention impact: compared to control-group counterparts, nurse-visited 18-year-olds born to mothers with limited psychological resources exhibited better cognitive functioning; females, as a trend, had fewer convictions. There were no significant effects on behavioral health.

Contributor's Statement Page

Dr. Olds conceptualized and designed the study, analyzed and interpreted data, drafted the manuscript, critically revised the manuscript for important intellectual content, obtained funding, and supervised the study.

Dr. Kitzman conceptualized and designed the study, analyzed and interpreted data, critically revised the manuscript for important intellectual content, obtained funding, and supervised the study.

Dr. Cole conceptualized and designed the study, analyzed and interpreted data, critically revised the manuscript for important intellectual content, and obtained funding.

Mr. Knudtson acquired data, analyzed and interpreted data, critically revised the manuscript for important intellectual content, and performed statistical analysis on data.

Dr. Smith and Ms. Anson acquired data, analyzed and interpreted data, and critically revised the manuscript for important intellectual content.

Dr. Conti analyzed and interpreted data and critically revised the manuscript for important intellectual content.

Drs. Fishbein, DiClemente, Wingood, Caliendo, Hopfer, and Miller conceptualized and designed the study, analyzed and interpreted data, and critically revised the manuscript for important intellectual content.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Abstract

Background and Objectives: Given earlier effects found in randomized clinical trials of the Nurse-Family Partnership (NFP), we examined whether NFP would improve 18-year-old first-born youths' cognition, academic achievement, and behavior; and whether effects on cognitive-related outcomes would be greater for youth born to mothers with limited psychological resources, and on arrests and convictions among females.

Methods: We enrolled 742 pregnant, low-income women with no previous live births and randomly assigned them to receive either: free transportation for prenatal care plus child development screening and referral (Control n=514), or prenatal and infant home visiting by nurses plus transportation and screening (NV n=228). Assessments were completed on 629 18-year-old first-born offspring to evaluate these primary outcomes 1) cognitive-related abilities: nonverbal intelligence, receptive language, and math achievement; and 2) behavioral health: internalizing behavioral problems, substance use and abuse, STI's, HIV risk, arrests, convictions, and gang membership.

Results: Compared to control-group counterparts, NV youth born to mothers with limited psychological resources had better receptive language (ES= 0.24, 95% CI: 0.00, 0.47, p=.05), math achievement (ES=0.38, 95% CI= 0.14, 0.61, p=.002) and a number of secondary cognitive-related outcomes. NV females, as a trend, had fewer convictions (IR=0.47, 95% CI 0.20, 1.11, p=.08). There were no intervention effects on other behaviors.

Conclusions: The program improved the cognitive-related skills of 18-year-olds born to mothers with limited psychological resources, and, as a trend, reduced female convictions, but produced no other effects on late-adolescent behavioral health.

INTRODUCTION

The potential of early intervention to improve the lives of children born into disadvantaged families has gained considerable attention. [1,2] Pregnancy and the early years of life are opportune times to intervene because of significant neuroendocrine changes in mothers, the developing fetus, and young child. [3.4] Prenatal and early childhood exposures to toxicants, maltreatment, and stress are thought to amplify one another over time, contributing to compromised life-course development, making this an opportune time to intervene to improve vulnerable children's development. [5] Our team has been conducting a series of pragmatic randomized clinical trials (RCTs) of a program of prenatal and infant/toddler home visiting by nurses for low-income mothers and their children known as the Nurse-Family Partnership (NFP). [6-20] The current study assesses 629 primarily African-American first-born 18-year-old youth whose mothers participated in the second RCT of the NFP in Memphis, TN.[11-17]

Findings from the current trial [11-16] and NFP trials conducted earlier in Elmira, NY [6-10] and later in Denver, CO, [18-20] led us to hypothesize that the NFP would improve 18-year-old youths' language, cognition, and math achievement; and that effects in this broad domain would be most pronounced for youth born to mothers with limited psychological resources (LPR) to cope with adversity - in the lower half of the distribution on an index composed of maternal intellectual functioning,[21] mental health, [22] and sense of mastery[23] / self-efficacy (mothers' beliefs about the importance of and their confidence in accomplishing key NFP behavioral objectives) [24] measured at baseline. [11]

Given NFP effects on substance use and antisocial behavior through age 15 among youth born to disadvantaged mothers in the Elmira trial [9] and substance use and internalizing disorders in the current trial at age 12,[15] we hypothesized that the program would reduce 18-year-olds's

internalizing disorders and substance-use and abuse disorders. In light of intervention effects on number of life-time sex partners through age 15 among youth born to disadvantaged mothers in Elmira, [9] and anticipated effects on substance abuse disorders in the current trial, we hypothesized that nurse-visited (NV) 18-year-olds would have fewer pregnancies and births and lower risk for HIV. Given NFP effects on arrests, convictions, and violations of probation among 15-year-olds born to disadvantaged mothers in the Elmira trial,[9] and substance use at age 12 in the current trial,[15] we hypothesized that the program would reduce rates of gang membership, arrests and convictions among 18-year-olds.

Prior to analysis of intervention-control differences, we found that program effects on arrests and convictions in Elmira were limited to females through age 19, [10] leading us to hypothesize corresponding female effects in Memphis. Also, given little meaningful variation in neighborhood disadvantage (2.4SD above the national mean[25]), we eliminated, prior to analysis of intervention effects, a hypothesis that program effects would be greater among youth whose mothers lived at registration in the most distressed neighborhoods.

PATIENTS AND METHODS

The basic features of this study have been reported earlier. [11] We conducted this RCT in a public system of obstetric and pediatric care in Memphis, TN, with registration of the original sample completed between June 1990 and August 1991. Given that program effects were more pronounced for mothers and children from more disadvantaged families in the preceding trial, [6-10] we focused sampling in Memphis on those with overlapping sociodemographic risks. We enrolled women <29 weeks gestation, with no previous live births, and at least 2 sociodemographic risks (unmarried, <12 years of education, unemployed). Ninety-two percent of the women were African-American, and at enrollment, 98% were unmarried, 64% < 18 years

of age, and 85% from households with incomes below the federal poverty guidelines. For the current follow-up, participating mothers, other caregivers, and youth completed informed consent procedures approved by the University of Rochester Institutional Review Board.

Table 1 summarizes the CONSORT information. Eighty-eight percent (1,138) of 1,289 eligible pregnant women offered participation completed informed consent and were randomized to one of four treatment conditions following a procedure that concealed assignment from individuals involved in gathering participant data.[11] Seven hundred forty two participants were assigned to two treatment conditions created to estimate program effects on postnatal outcomes: 514 to Treatment 2 (Control) and 228 to Treatment 4 (NV), both described below. Sample size and assignment ratios were derived from statistical power calculations in the original phase of the trial.[11] Table 1 shows those lost to follow-up because of miscarriage or child death, maternal or child refusal to participate at earlier phases; and the number evaluated with youth assessments and maternal/other custody interviews at youth age 18.

Interviews for this follow-up were conducted between October 2008 and September 2014; and reviews of school records by December 2015 by staff masked to treatment assignment. Most assessments were conducted after youths' 18th birthdays (mean age 18.67 years, SD=0.95, range-17.5 – 23.9). Some youth, because of disabling conditions or refusal, did not complete all assessments. Numbers of completed assessments for each outcome are given in Tables 4 and 5. Repeated measures of some outcomes over time increased the n's and are noted by All under the column Age at Assessment.

Interviews were completed with 629 of the 669 available youth. Interviews were conducted with mothers and other caregivers to augment youth report of arrest outcomes

(n=621), externalizing and total behavior problems (n=615), and to determine SSI disability (n=619). High school graduation records were collected on 619 youth and urine on 606.

Treatment Conditions

Women in the Control group (n = 514) were provided free transportation for scheduled prenatal care plus developmental screening and referral for children at 6, 12, and 24 months of age. Women in the NV condition (n = 228) were provided the same services as the Control group, plus prenatal and infancy home visitation through age two.

The NFP program was designed to 1) improve pregnancy outcomes by promoting women's prenatal health behaviors; 2) improve children's health and development by promoting parents' care of their children; and 3) enhance parents' health and life-course by encouraging planning the timing of subsequent pregnancies, completing their educations, and finding work. Nurses linked families with needed services and, when possible, involved other family members (especially children's fathers and grandmothers). [5] Program protocols were grounded in developmental epidemiology and theories of human attachment, human ecology, and self-efficacy; and adjusted to families' individual needs. [5]

The program was implemented by the Memphis/Shelby County Health Department during a nursing shortage, leading to nurse turn-over for 37% of the families. [11] Nurses carried a maximum caseload of 25 families each and relied upon detailed visit-by-visit guidelines structured around 62 home visits. It is impossible for nurses to complete 62 visits on all families, and most families do not need this level of service. Nurses used their clinical judgment to adjust dosage and visit content, as well as telephone communications when in-person visits were not possible, to address individual needs revealed in the conduct of visits.

All families were scheduled to receive 4 weekly visits at the beginning of the program to facilitate nurses' and mothers' getting to know one another as early in pregnancy as possible, and to develop a trusting relationship founded upon nurses' understanding of mothers' aspirations and concerns about their prenatal health, the developing fetus, birth, and the challenges of caring for newborns. Newborn health and mother's adjustment to caregiving were critical factors in nurses' decisions about visit dose and content. Nurses recorded features of program implementation on every attempted and completed visit. [5, 26, 27]

Overall, nurses completed a mean of 7 home visits during pregnancy and 26 visits during the first 2 years postpartum. [11, 27] Mothers in the lowest quartile of psychological resources at baseline received the highest number of home visits (mean=37.67, SE=2.38); those in the middle two quartiles had the fewest (mean=32.02, SE = 1.68); and those in the highest quartile of psychological resources received an intermediate number of visits (mean=34.26, SE=2.38).

Main Outcomes

Table 2 shows that outcomes were divided into two broad categories: 1) cognitive-related outcomes: nonverbal intelligence, language, math achievement, sustained attention, working memory, emotion recognition, risky decision-making, SSI disability, high school graduation, graduation with honors; and 2) behavioral health: mental health (internalizing, eternalizing, and total behavioral problems), substance use and abuse, STI's, HIV risk, arrests and convictions, and gang membership. Within these broad categories, we separated primary from secondary outcomes. Table 2 shows the specific measures used and bases for hypotheses. Primary outcomes were predicted from previous intervention effects on the same measures or constructs in earlier phases of the current trial or other NFP trials and, for some outcomes, from effects found at earlier phases. Secondary outcomes were selected on the basis of their epidemiologic

and theoretical associations with earlier effects in the Elmira or Memphis trials. [5-9,11-16, 18-19] We included two exploratory outcomes: high school graduation with honors and mother/caregiver report of youth receipt of Supplemental Social Security Income (SSI) for disability.

Statistical Models and Methods of Analysis

Data analyses are reported on all cases randomized insofar as outcome data were available. The analysis adhered to a statistical analysis plan established before examination of data from the intervention group.

The primary statistical model for cognitive-related outcomes consisted of a 2-level treatment factor (Control vs. NV), a 2-level factor reflecting mothers' psychological resources (PR - above versus below the sample median), focusing on treatment differences for the LPR group, in models that included 3 covariates (household poverty index, maternal attitudes predictive of child abuse (CA attitudes), [43] and youth sex). The first two covariates, consistent predictors of a range of outcomes, adjusted for treatment non-equivalence at registration; the third was added because of its strong relationship with some outcomes. The household poverty index incorporates three variables: discretionary household income, housing density, and head of household employment. For emotion-recognition analyses, we added age-18 nonverbal intelligence to the model to reduce the likelihood that intervention effects would simply reflect differences in intelligence.

For arrest and conviction outcomes, we examined NV-Control differences in a model that included sex as a classification factor, examining treatment differences separately for females and males, in models that included three covariates: maternal PR, household poverty, and CA attitudes.[43]

Given that rates of pregnancies, births, and STI outcomes were operationalized

differently for males and females, we examined NV – Control differences separately for males and females, and included three covariates: maternal PR, household poverty and CA attitudes.[43]

For analysis of HIV risk, we examined NV – Control differences in a model that included covariates for maternal PR, youth sex, youth age at assessment, household poverty, and CA attitudes.[43]

For all remaining behavioral health outcomes, we examined NV – Control differences in models that included covariates for maternal PR, youth sex, household poverty, and CA attitudes.[43]

For continuous and dichotomous outcomes on which we had repeated assessments for each child over time, we analyzed outcomes using generalized mixed models that included, in addition to variables from the primary model, children as levels of a random factor, a fixed repeated-measures classification factor for time of assessment, and all interactions of time with the other fixed classification factors.

Continuous dependent variables were analyzed in the general linear model and dichotomous outcomes in the logistic-linear model. For low-frequency count outcomes, we analyzed data in generalized linear models with negative binomial error assumptions. We examined low frequency outcomes with re-randomization tests to determine model fit [44] and truncated one outlier for the count-of-convictions outcome. Substance use disorders and timing to first pregnancy and birth were analyzed over time using Cox proportional-hazards models. We present survival rates at age 18 along with hazard ratios.

An online supplement shows estimates of NV – Control differences without covariate adjustments.

RESULTS

The NV and Control groups were similar on background characteristics for participants on whom 18-year follow-up assessments were conducted (Table 3), with these exceptions: at intake, NV women, compared to Controls, lived in households with less discretionary income, higher person-per-room density, higher scores on a household poverty index, and higher scores on CA attitudes. [43]

Cognitive, Language, Achievement, and Executive Functioning Outcomes

Table 4 summarizes estimates of youth functioning in the cognitive, language, achievement, and executive functioning domains for the sample as a whole and for youth born to LPR mothers. With the exception of NV youth having higher rates of graduation with honors (AOR=2.12, 95% CI: 1.09, 4.13, p=.028), and trends (p<.10) for NV youth to have higher math scores and better emotion recognition, there were no intervention-control differences for the sample as a whole. NV children born to LPR mothers, on the other hand, at age 18, had better receptive language (ES= 0.24, 95% CI: 0.00, 0.47, p=.048) and math achievement (ES=0.38, 95% CI= 0.14, 0.61, p=.002). For both of these outcomes, there were longitudinal effects over time. There were no intervention-control differences in nonverbal intelligence.

NV children born to LPR mothers also had better working memories (ES=0.23, 95% CI= 0.01, 0.46, p=.045), emotion-recognition abilities (ES=0.22, 95% CI: 0.01, 0.44, p=.040), lower SSI disability (AOR= 0.33, 95% CI: 0.13, 0.84, p=.011), and higher rates of high school graduation with honors (AOR=3.34, 95% CI: 1.19, 9.34, p=.022) than their control-group counterparts.

There were no intervention-control differences in children's sustained attention, risky decision-making, or high-school graduation.

Behavioral Health

Table 5 shows that NV females, as a trend, had fewer criminal convictions than Control females (IR=0.47, 95% CI 0.20, 1.11, p=.080). There were no intervention-control differences in internalizing, externalizing or total behavioral problems, or in substance use and disorders. There was a marginally significant difference for NV males, compared to Control males, to report more convictions for interpersonal violence (IR=2.15, 95% CI 0..90, 5.27, p=.082), data not shown. There were no overall NV-Control differences in STI's, timing to first pregnancy, timing to first live birth, HIV risk, gang participation, counts of arrests, convictions, arrests or convictions for interpersonal violence.

DISCUSSION

There were no overall intervention-control differences for any of the behavioral health outcomes, but the program improved the receptive language and math achievement of 18-year-olds born to LPR mothers, and, as a trend, reduced convictions among females. In addition, NV youth graduated with honors more frequently and those born to LPR mothers, compared to control-group counterparts, had better working memories, emotion-recognition skills, and fewer disabilities leading to receipt of SSI. High rates of sample retention increase the validity of these findings.

The program effect on cognitive-related outcomes was, with the exception of graduation with honors, limited to youth born to mothers with LPR, conditional effects consistent with earlier phases of this trial, [11-15] and a subsequent trial.[18-20] Most of these effects, except for the two-fold increase in graduation with honors overall and three-fold reduction in SSI disability in the LPR group, are small by conventional standards,[45] but important because they reflect different aspects of cognition, disability, and academic success relevant to adult functioning. Moreover, most of these outcomes are based upon directly measured abilities.

Program effects on emotion-recognition abilities and working memory, while not examined in other NFP trials, are consistent with a reduction in child maltreatment, [46, 47] and earlier program effects on maltreatment-related outcomes. [11, 13, 17] By age two, for example, Control children, compared to those visited by nurses, were hospitalized fewer days for injuries and ingestions; [11] all admissions for fractures and/or head trauma occurred in LPR Control infants. [5, 11] LPR Control children were less communicative and responsive to their mothers than those visited by nurses through 24 months; [11] and through age 18 exhibit more compromised development and achievemennt.[13, 17] All preventable child mortality through age 20 occurred in the Control group.[17]

The improvements in cognitive outcomes and reductions in disability in the LPR group at age 18 suggest that the intervention may lead to additional functional and societal savings for this group, including possible reductions in Alzheimer disease and related disorders given their relationship with adolescent cognitive functioning.[48, 49]

In interpreting the more pronounced program effect on the cognitive-related outcomes of children born to LPR mothers, it is important to note that nurses visited the most vulnerable mothers more frequently, a consistent feature of NFP program design beginning with the Elmira trial. [26] Moreover, children born to LPR mothers had greater room for improvement.

Note that families were not randomly assigned to different visitation schedules, so discerning the role of visit patterns on outcomes is challenging. In exploratory latent class analyses of home visits in the current trial, three patterns were uncovered - low attendance (33% of those visited), high attendance (48%), and increasing attendance (18%). Those in the low–visit group had the highest educations at baseline; those in the increasing group had low education, the lowest number of prenatal visits, and high rates of preterm delivery; and those in

the high-visit group also had low educations at baseline. These findings highlight the role that mothers, in addition to nurses, play in shaping visit attendance patterns, and the methodologic challenges involved in estimating intervention effects for those with different visitation patterns.[27]

In using the visit patterns found here to guide community replication, [5] it is important to emphasize that the dosage metric which the NFP is designed to achieve is the one actually delivered in the original RCT's, and that nurses adjusted visit-frequency and content in an effort to ensure that they address specific risks and guide responsive caregiving in the most vulnerable subgroups.

The program effect on convictions among females, while a trend, is consistent with a corresponding finding in the Elmira trial, [10] reduced physical aggression among females at age two in the current trial, [50] and intervention effects on trajectories of externalizing problems in the subsequent Denver trial among females, but not males, at ages 2, 4, 6, and 9. [51] These female-limited beneficial effects may be connected to females' particular susceptibility to the effects of prenatal stress on androgen activity during gestation [52] and hormone-dependent endpoints, including conduct disorder. [53] Moreover, females, compared to males, are particularly susceptible to the effects of harsh parenting on health, [54, 55] including the development of aggression. [56]

There were no beneficial intervention effects in the current trial on 18-year-olds's substance-use disorders, substance use, or internalizing disorders, in spite of significant intervention effects in these domains at age 12 in the current trial, [15] and on substance use, arrests and convictions through age 15 in the Elmira trial. [9] The trend for NV males to report higher rates of convictions for interpersonal violence was not predicted. The absence of overall

beneficial intervention effects on antisocial behavior at the end of adolescence, especially among males, is consistent with age-19 findings in the Elmira trial. [10] There are at least two possible explanations for this pattern of results.

The first is that NFP's promotion of sensitive, responsive care and avoidance of harsh treatment may have decreased parents' attention to setting effective limits, especially among non-compliant males. [56] The increase in NV males' self-reported convictions for interpersonal violence found here, while not hypothesized, suggests that greater attention may be need to address effective limit-setting in the NFP and to link this program to effective toddler and preschool parenting interventions. [57-60]

Second, the nearly normative rise in male adolescent-limited antisocial behavior not linked to maltreatment or early adversity [61] may mask intervention effects on life-course persistent antisocial behavior linked to early maltreatment that may become evident once adolescents assume adult roles. Note, however, that adolescents who become ensnared in substance abuse and criminal activity are at risk for long-term criminal involvement.[61-63]

The current report has limitations. The first is that nearly all of the behavioral health findings were based upon self-report and some evidence suggests that NV women become more accurate reporters of socially undesirable behavior, such as smoking. [6] While a case might also be made that nurse-visited youth were more attentive listeners and reporters (given program effects on verbal working memory), measurement of STI's and use of substances included urine assays so this form of treatment-related report bias does not account for the absence of intervention effect for these outcomes.

Second, we included two exploratory outcomes (high school graduation with honors and SSI disability) that were not part of the original measurement design, so these findings need to be

treated with caution.

Third, the age range for completing 18-year assessments was larger than anticipated, but not different by treatment. Adjusting for youth age at assessment does not alter the findings (data not shown).

The fourth limitation is that the number of outcomes analyzed raises challenges with multiple comparisons. We have not adjusted for multiple comparisons in NFP trials. [64-67] We have focused instead on determining whether findings replicate with different populations living in different contexts in separate trials. The long-term program effect on cognitive-related outcomes through the end of adolescence has not yet been tested in other trials, so particular caution is warranted in interpreting these outcomes.

CONCLUSION

This study found enduring program effects on the cognitive functioning of youth born to mothers least capable of coping with the adversities that come with living in poverty, and a trend for reduced convictions among females, but no effects on other adolescent health behavior.

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Michael Knudtson had full access to all of the data in the study and takes responsibility for the integrity of the data and accuracy of the data analysis.

Additional Contributions

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Table 1. CONSORT information for youth enrolled in trial through 18-year follow-up

Eligible Subjects Invited to Participate	1290				
Number declined participation	151				
Number Randomized	1138				
Treatment Group Assignment	**1[a]**	**2[b]**	**3[c]**	**4[d]**	**Total (TX 2 & 4)**
Number allocated to each treatment	166	514 [e]	230	228	742
Miscarriages	6	19	6	8	27
Stillbirths	0	5	3	2	7
Child death before age 18		10		2	12
Mother declined participation after randomization		15		11	26
Child declined participation prior to age 18		1		0	1
Available for 18-year follow-up [f]		**464**		**205**	**669**
Completed age-18 youth assessment [g]		435		194	629
Completed maternal and/or other custody interview for youth arrests [h]		429		192	621
Completed maternal or other custody interview for CBCL externalizing and total behavior problems [i]		428		187	615
Completed maternal or other custody interview for SSI disability		429		190	619
Collected youth urine [j]		419		187	606
Completed review of high school graduation records		431		188	619

[a] Treatment 1 - Prenatal transportation

[b] Treatment 2 - Prenatal transportation + developmental screening and referral

[c] Treatment 3 - Prenatal transportation + developmental screening and referral + prenatal nurse home visits

[d] Treatment 4 - Prenatal transportation + developmental screening and referral + prenatal and infant/toddler nurse home visits

[e] Note that one mother was enrolled and randomized twice by mistake following a miscarriage. We included her only once with her original assignment to the control group

[f] Some outcomes reported in Tables 4 and 5 below show higher numbers than indicated in this table because they include repeated estimates of outcomes from earlier phases of follow-up, indicated by All under Age at Assessment in those tables.

[g] Some youth were unable or unwilling to complete the standardized psychological or achievement assessments, or provide urine to screen for STI's or substances, reducing the numbers shown in Tables 4 and 5 below.

[h] Youth arrests were derived from a detailed examination of self-report, maternal and other caregiver report, synthesizing data from all three data sources (when available); this row shows the number of cases for which data were gathered from maternal and/or other caregiver report. Estimates of arrest-related outcomes were made even if maternal and other caregiver reports were unavailable.

[i] Youth CBCL externalizing and total behavioral problems (borderline/clinical) were derived from a combination of youth self-report and either maternal or other-caregiver report. Maternal report was given priority over other-caregiver.

[j] Some youth were unable or refused to provide urine for substance-use or STI screening. One sample was unusable for STI screening.

Table 2. Outcome Domains, Variables Measured, and Bases for Hypotheses

Outcome Domains and Variables Measured [a]	Basis for Hypotheses [b]			
Primary Cognitive-Related Outcomes	**Earlier Effect in Current Trial**	**Effect in Other Trial**	**Predicted from Earlier Phases or Trials**	**Conditional Effect**
Nonverbal Intelligence			X[5-9,11-16, 18-19]	LPR [f]
Kaufman Brief Intelligence Test, Matrices Subtest (KBIT–2) [28, c]	X[13]			
Receptive Language		X[17-18]	X[5-9,11-16, 18-19]	LPR [f]
Peabody Picture Vocabulary Test–III (PPVT) [30]	X[13]			
Math Achievement			X[5-9,11-16, 18-19]	LPR [f]
Peabody Individual Achievement Test, Math Subtest [31]	X[13,15]			
Secondary Cognitive-Related Outcomes				
Sustained Attention		X[18]	X[5-9,11-16, 18-19]	LPR [f]
Leiter-R Sustained Attention Test [32]				
Verbal Working Memory Index			X[5-9,11-16, 18-19]	LPR [f]
WAIS number recall sequences [33]				
Emotion Recognition			X[5-9,11-16, 18-19]	LPR [f]
Facial Emotion Recognition Task (no. correct) [34]				
Risky Decision Making			X[5-9,11-16, 18-19]	LPR [f]
Cambridge Decision-Making Test (CDMT) [35]				
High School Graduation - %			X[5-9,11-16, 18-19]	LPR [f]
Administrative records and self-report				
Exploratory Cognitive-Related Outcomes				
High School Graduation with Honors [d] - %			X[5-9,11-16, 18-19]	LPR [f]
Administrative records				
Supplemental Social Security Income (SSSI) – Disability [e]			X[5-9,11-16, 18-19]	LPR [f]
Maternal/Caregiver report of enrollment				
Primary Behavioral Health Outcomes				
Internalizing Behavioral Problems (Borderline/Clinical)			X[5-9,11-16, 18-19]	
Youth self-report ages 11-18 - Achenbach System [36]	X[15]			
Current Substance Use	X[15]		X[5-9,11-16, 18-19]	
Drug Use Screening Inventory (Adolescent Version) [37] + urine screens for cotinine, PCP, benzodiazepines, cocaine, amphetamines, THC, opiates, and barbiturates – coded yes/no				
Substance Use Disorder			X[5-9,11-16, 18-19]	
CIDI-SAM [38]				
Sexually Transmitted Infections			X[5-9,11-16, 18-19]	
N gonorrhoeae, C. trachomatis, and T vaginalis [39-41]				
HIV Risk			X[5-9,11-16, 18-19]	
Risky sexual behaviors, STI's, and pregnancies [42]				
Arrests and Convictions		X[9,10]	X[5-16, 18-19]	FEMALES
Counts of self- and maternal/caregiver-reported arrests and convictions prior to age 18 for all offenses and for interpersonal violence				
Gang Membership			X[5-9,11-16, 18-19]	
Self-report				

Outcome Domains and Variables Measured [a]	**Basis for Hypotheses** [b]			
Secondary Behavioral Health Outcomes				
Externalizing & Total Behavioral Problems (Borderline/Clinical)	X[13]		X[5-9,11-16, 18-19]	
Achenbach Assessment [36] - Self- and maternal/caregiver report both crossing the borderline or clinical threshold				

[a] Outcome domains are listed in bold italics. Specific variables assessed are shown under each outcome domain. Outcomes were selected on the basis of their being affected in earlier phases of this trial, the preceding trial, or on theoretical and epidemiologic grounds, with attention to those aspects of functioning that are of clinical or public health importance and that could be assessed without over-burdening respondents.

[b] We show the bases for hypotheses in three categories: 1) an earlier effect on the same specific measure or construct in an earlier phase of the trial; 2) an effect on the same measure or construct in other trials; and 3) effects in earlier phases or trials that predict the current outcomes on theoretical or epidemiologic grounds. When the prediction was made from the same measure, the basis for the hypothesis is shown on the same row; otherwise it is shown on the construct row (bold italics). Note that those outcomes hypothesized to be greater for particular subgroups are shown in the last column.

[c] The intervention effect on nonverbal intelligence at age 6 was a trend overall and for the LPR group, derived from the KABC Mental Processing Composite.[29] The analysis of the whole scale KABC mental processing composite was significantly different for the treatment-control contrast, both overall and for LPR at age 6.[13] The nonverbal subscale trend was not reported in the earlier publication.[13] The KBIT-2 administered at age 18 is a shortened version of intellectual functioning based upon the full-scale KABC.

[d] Exploratory outcome. Graduating with honors was not part of the original measurement design per se. The original plan called for gathering school records of grade point averages and disciplinary records, which were incomplete, leading us to eliminate them as part of the final measurement design. We discovered, however, that states sent information on graduation with honors, which aligns with the original measurement design and thus is included in this report. Note that all states to which participants moved record graduating with honors, with the exception of Mississippi. Seventeen cases graduated from MS schools (10 Control, 7 NV); they are included in the analysis as not having graduated with honors.

[e] Exploratory outcome. SSI disability was based upon parent/caregiver report and not included in the original measurement design. The question is relevant to this report and thus included here.

[f] LPR= Limited Psychological Resources. Subgroup defined by youths' mothers at registration [10] falling into the lower half of the distribution of an index composed of the average z-scores of women's intellectual functioning,[21] mental health,[22] and sense of mastery[23]/self-efficacy (based upon participants' confidence in their ability to accomplish key NFP behavioral objectives). [24]

Table 3: Background characteristics at randomization of those participants for whom 18-year assessments were completed

		Control (T2)		Nurse Visited (T4)	
Variable	Group	N	% or Mean(SD)	N	% or Mean(SD)
Male Sex - %	Whole	435	48.3	194	49.0
	LPR [a]	230	43.9	108	51.9
Mother Married- %	Whole	435	1.8	194	1.0
	LPR [a]	230	1.3	108	1.9
Maternal Race, Black- %	Whole	435	93.6	194	90.7
	LPR [a]	230	95.2	108	90.7
Head of Household Employed- %	Whole	434	56.5	193	49.2
	LPR [a]	229	52.4	107	48.6
Drank Alcohol Last 14 Days- %	Whole	434	4.4	194	5.2
	LPR [a]	229	5.7	108	7.4
Smoked Cigarettes Last 3 Days- %	Whole	434	8.5	194	10.8
	LPR [a]	229	7.9	108	13.0
Used Marijuana Last 14 Days- %	Whole	434	1.6	194	1.0
	LPR [a]	229	1.7	108	1.9
Any Sexually Transmitted Disease before Randomization- %	Whole	432	33.3	194	37.6
	LPR [a]	227	33.0	108	38.9
Maternal Age, y	Whole	435	18.10 (3.20)	194	18.08 (3.32)
	LPR [a]	230	18.13 (3.31)	108	18.30 (3.85)
Gestational Age, wks	Whole	435	16.56 (5.74)	194	16.72 (5.71)
	LPR [a]	230	16.39 (5.79)	108	16.68 (5.63)
Psychological Resources Index [b, c]	Whole	434	99.87 (9.92)	194	99.36 (10.69)
	LPR [a]	229	92.34 (5.80)	108	91.85 (6.71)
Highest Grade Completed – Mother	Whole	435	10.26 (1.88)	194	10.08 (2.04)
	LPR [a]	230	9.93 (1.94)	108	9.62 (2.06)
Discretionary Annual Household Income (/$1000) [d]	Whole	435	1.57 (6.99)	194	-0.18 (6.45)
	LPR [a]	230	-0.19 (6.50)	108	-1.07 (6.16)
% of Census Tract Below Poverty	Whole	435	34.85 (21.34)	194	35.30 (20.48)
	LPR [a]	230	36.40 (21.08)	108	34.49 (21.31)
Housing Density [e]	Whole	435	0.95 (0.50)	194	1.04 (0.57)
	LPR [a]	230	1.04 (0.53)	108	1.12 (0.52)
Conflict with Mother [f]	Whole	434	3.99 (0.90)	194	4.03 (0.74)
	LPR [a]	229	4.15 (1.09)	108	4.09 (0.80)
Conflict with Partner [f]	Whole	434	3.97 (0.83)	194	4.07 (0.83)
	LPR [a]	229	4.08 (0.96)	108	4.21 (0.96)
Attitudes toward Childrearing Predictive of Child Abuse [g]	Whole	435	99.88 (7.64)	194	101.08 (8.48)
	LPR [a]	230	102.33 (7.06)	108	103.34 (7.70)
Household Poverty Index [c, h]	Whole	435	99.63 (10.16)	194	102.19 (9.91)
	LPR [a]	230	101.94 (10.09)	108	103.72 (9.82)

		Control (T2)		Nurse Visited (T4)	
Variable	Group	N	% or Mean(SD)	N	% or Mean(SD)
Neighborhood Disadvantage Index [i]	Whole	435	2.33 (1.64)	194	2.38 (1.82)
	LPR [a]	230	2.50 (1.60)	108	2.24 (1.72)

[a] LPR = Subgroup defined by youths' mothers falling into the lower half of the distribution for psychological resources (limited psychological resources) described in the following footnote.
[b] Average z-scores of women's intellectual functioning,[21] mental health,[22] and sense of mastery[23]/self-efficacy[24] (mastery and self-efficacy measures standardized and averaged; self-efficacy based upon participants' beliefs about the importance of and their confidence in accomplishing key NFP behavioral objectives).
[c] Standardized to sample mean = 100, SD = 10
[d] Annual household discretionary income based upon income subsistence standards for Medicaid eligibility, reported household income, and number of individuals in household at registration.
[e] Persons per room
[f] Locally developed scale that assesses degree to which mother experiences conflict in relationship with this person.
[g] Adult-Adolescent Parenting Inventory [43]
[h] Average z-scores of household discretionary income, housing density, and whether head of household was employed.
[i] Average of variables calculated in standard deviation units from the national means of components that comprise index of concentrated social disadvantage (% of block group residents: a) < federal poverty level, b) receiving public assistance, c) unemployed, d) headed by single women; e)< age 18; f) black). [25]

Table 4. Estimates of youth's cognitive, language, academic, executive functioning and Supplemental Social Security Benefit received among 18-year old youth in intervention and control conditions [a]

			Control (T2)		Nurse Visited (T4)		T4-T2	
Variable	**Group**	**Child Age at Assessment [b]**	**N**	**LS-Mean [c] or % (SE)**	**N**	**LS-Mean [c] or % (SE)**	**ES [d] or AOR [e] (95% CI)**	**P-value**
Primary Outcomes								
Nonverbal Intelligence	Whole	18y	431	88.25 (0.62)	192	88.47 (0.93)	0.02 (-0.17 , 0.20)	0.85
	LPR [f]	18y	227	86.37 (0.86)	106	87.41 (1.26)	0.09 (-0.16 , 0.34)	0.49
	Whole	All [g]	454	88.65 (0.47)	204	89.58 (0.71)	0.08 (-0.06 , 0.22)	0.27
	LPR [f]	All [g]	237	87.16 (0.66)	111	88.69 (0.98)	0.13 (-0.06 , 0.32)	0.19
Receptive Language	Whole	18y	427	81.60 (0.69)	194	82.34 (1.03)	0.05 (-0.12 , 0.23)	0.55
	LPR [f]	18y	223	79.02 (0.96)	108	82.32 (1.39)	0.24 (0.00 , 0.47)	0.05 *
	Whole	All [g]	454	82.08 (0.56)	204	83.33 (0.83)	0.09 (-0.05 , 0.23)	0.21
	LPR [f]	All [g]	237	79.91 (0.78)	111	82.79 (1.14)	0.21 (0.02 , 0.40)	0.03 *
Math achievement score	Whole	18y	428	80.38 (0.59)	193	82.22 (0.88)	0.15 (-0.02 , 0.32)	0.08 (*)
	LPR [f]	18y	225	78.18 (0.82)	108	82.73 (1.19)	0.38 (0.14 , 0.61)	0.002 **
	Whole	All [h]	454	85.22 (0.47)	205	86.54 (0.71)	0.11 (-0.03 , 0.25)	0.12
	LPR [f]	All [h]	237	82.89 (0.66)	111	86.70 (0.98)	0.31 (0.13 , 0.50)	0.001 **
Secondary Outcomes								
Sustained Attention	Whole	18y	432	8.68 (0.13)	194	8.77 (0.19)	0.03 (-0.13 , 0.20)	0.67
	LPR [f]	18y	227	8.22 (0.18)	108	8.60 (0.26)	0.14 (-0.08 , 0.36)	0.22
	Whole	All [i]	443	8.68 (0.12)	199	8.67 (0.18)	-0.00 (-0.15 , 0.15)	0.97
	LPR [f]	All [i]	232	8.45 (0.17)	110	8.57 (0.24)	0.04 (-0.16 , 0.24)	0.67
Working Memory Index	Whole	18y	432	8.33 (0.13)	194	8.66 (0.19)	0.12 (-0.04 , 0.29)	0.15
	LPR [f]	18y	227	7.90 (0.18)	108	8.51 (0.26)	0.23 (0.01 , 0.46)	0.04 *
Emotion Recognition – no. correct	Whole	18y	427	52.55 (0.37)	190	53.75 (0.56)	0.14 (-0.01 , 0.30)	0.08 (*)
	LPR [f]	18y	225	52.32 (0.52)	104	54.19 (0.77)	0.22 (0.01 , 0.44)	0.04 *

			Control (T2)		Nurse Visited (T4)		T4-T2	
Variable	**Group**	**Child Age at Assessment [b]**	**N**	**LS-Mean [c] or % (SE)**	**N**	**LS-Mean [c] or % (SE)**	**ES [d] or AOR [e] (95% CI)**	**P-value**
Risky Decision Making	Whole	18y	430	5.23 (0.19)	193	4.92 (0.29)	-0.08 (-0.25 , 0.10)	0.38
	LPR [f]	18y	227	5.02 (0.27)	107	4.95 (0.39)	-0.02 (-0.25 , 0.21)	0.88
High School Graduation %	Whole	18y	431	71.8% (2.22%)	188	75.5% (3.26%)	1.21 (0.81 , 1.82)	0.35
	LPR	18y	227	70.3% (3.14%)	106	71.4% (4.51%)	1.06 (0.63 , 1.76)	0.83
Graduate with Honors % [j]	Whole	18y	431	4.4% (1.05%)	188	8.8% (2.12%)	2.12 (1.09 , 4.13)	0.03 *
	LPR	18y	227	2.5% (0.99%)	106	8.0% (2.70%)	3.34 (1.19 , 9.34)	0.02 *
SSI Disability-% [j]	Whole	18y	429	5.8% (1.30%)	190	3.4% (1.27%)	0.58 (0.25 , 1.34)	0.19
	LPR [f]	18y	226	10.9% (2.21%)	104	3.9% (1.70%)	0.33 (0.13 , 0.84)	0.01 *

[a] The estimates of intervention-control differences averaged over all other fixed classification variables, including those within subjects, and the same treatment effect restricted to the group defined by LPR. This table shows the least squares means at 18 years and repeated measures over time (labeled All under Age at Assessment), which also are averaged over other fixed classification effects. For estimates of treatment effects based upon repeated measures, we assumed an error structure with different variances at each time for a given child and different covariance between pairs of times within each child. These were assumed to be the same for all children and covariance between children were assumed to be negligible. Contrasts at specific earlier time points are presented in earlier publications.[11-16]

[b] Child Age at Assessment: Age 18 assessment denoted by 18y; repeated measures assessment denoted by All. The exact ages aggregated for repeated measures estimates are given in footnotes below.

[c] LS Mean = Least Squares (adjusted) mean

[d] ES = Effect Size (expressed in standard deviation units)

[e] AOR = Adjusted Odds Ratio

[f] LPR = Subgroup defined by youths' mothers falling into the lower half of the distribution for psychological resources (limited psychological resources)

[g] Ages 6 and 18

[h] Ages 6, 12 and 18

[i] Ages 12 and 18

[j] Exploratory outcome

(*) P<.10

* P<.05

** P<.01

Table 5. Estimates of youths' substance-use disorders, drug or alcohol use, STI's, pregnancies, births, behavioral problems, arrests, convictions, and gang activity [a]

			Control (T2)		Nurse Visited (T4)		T4-T2	
Variable	Group	Child Age at Assessment	N	LS-Mean [h] or % (SE)	N	LS-Mean [h] or % (SE)	ES [i] or AOR [j] or IR [k] or HR [l] (95% CI)	P-value
Primary Outcomes								
Time to Substance Use Disorder % [b, c]	Whole	18y	435	10.5% (1.41%)	194	13.2% (2.22%)	1.28 (0.85 , 1.93)	0.24
Current drug use SR past month or positive lab test % [d]	Whole	18y	423	48.4% (2.49%)	190	51.1% (3.73%)	1.11 (0.78 , 1.58)	0.55
Time to First Pregnancy % [b, c]	Males	18y	210	17.2% (2.56%)	95	15.0% (3.30%)	0.86 (0.51 , 1.46)	0.57
	Females	18y	225	26.4% (2.92%)	99	22.8% (3.95%)	0.85 (0.54 , 1.32)	0.46
Time to First Live Birth % [b, c]	Males	18y	210	6.3% (1.60%)	95	7.5% (2.37%)	1.20 (0.58 , 2.49)	0.62
	Females	18y	225	16.8% (2.45%)	99	13.7% (3.21%)	0.80 (0.46 , 1.41)	0.44
Any positive STI lab test %	Males	18y	198	15.4% (2.58%)	88	14.8% (3.82%)	0.95 (0.47 , 1.94)	0.89
	Females	18y	220	22.8% (2.87%)	99	25.5% (4.47%)	1.16 (0.66 , 2.04)	0.60
HIV Risk (log-transformed)	Whole	18y	417	-13.50 (0.17)	187	-13.77 (0.26)	-0.08 (-0.25 , 0.10)	0.38
Internalizing Behavior Problems % [e, f]	Whole	18y	431	17.7% (1.93%)	194	16.5% (2.79%)	0.92 (0.57 , 1.48)	0.73
	Whole	All [f]	459	20.4% (1.35%)	207	17.4% (1.85%)	0.82 (0.61 , 1.11)	0.19
No. Arrests [b]	Whole	18y	435	0.35 (0.05)	194	0.36 (0.08)	1.02 (0.61 , 1.70)	0.93
	Females	18y	225	0.23 (0.05)	99	0.19 (0.06)	0.84 (0.39 , 1.81)	0.65

			Control (T2)		Nurse Visited (T4)		T4-T2	
Variable	Group	Child Age at Assessment	N	LS-Mean [h] or % (SE)	N	LS-Mean [h] or % (SE)	ES [i] or AOR [j] or IR [k] or HR [l] (95% CI)	P-value
No. Convictions [b]	Whole	18y	435	0.28 (0.04)	194	0.24 (0.06)	0.86 (0.50 , 1.47)	0.59
	Females	18y	225	0.21 (0.04)	99	0.10 (0.04)	0.47 (0.20 , 1.11)	0.08 (*)
No. Interpersonal Violence Arrests [b]	Whole	18y	435	0.14 (0.03)	194	0.19 (0.05)	1.39 (0.73 , 2.65)	0.32
	Females	18y	225	0.09 (0.03)	99	0.14 (0.05)	1.48 (0.57 , 3.86)	0.42
No. Interpersonal Violence Convictions [b]	Whole	18y	435	0.10 (0.02)	194	0.13 (0.04)	1.33 (0.66 , 2.65)	0.43
	Females	18y	225	0.08 (0.02)	99	0.07 (0.03)	0.81 (0.28 , 2.34)	0.69
Ever in gang % [b]	Whole	18y	432	8.5% (1.44%)	193	11.2% (2.31%)	1.35 (0.80 , 2.28)	0.27
Secondary Outcomes								
Externalizing Behavior Problems % [g]	Whole	18y	424	7.4% (1.31%)	187	8.3% (2.08%)	1.13 (0.59 , 2.17)	0.72
	Whole	All [f]	459	14.1% (1.20%)	206	14.4% (1.80%)	1.02 (0.72 , 1.44)	0.91
Total Behavior Problems % [f, g]	Whole	18y	424	4.4% (1.01%)	187	6.8% (1.89%)	1.60 (0.75 , 3.39)	0.22
	Whole	All [f]	459	8.2% (0.95%)	206	7.7% (1.48%)	0.94 (0.58 , 1.51)	0.79

[a] The estimates of intervention-control differences averaged over all other fixed classification variables, including those within subjects, and the same treatment effect restricted to the group defined by females for arrest and conviction outcomes. This table shows the least squares means at 18 years and repeated measures over time, which also are averaged over other fixed classification effects. For estimates of treatment effects based upon repeated measures (labeled All under Age at Assessment), we assumed an error structure with different variances at each time for a given child and different covariance between pairs of times within each child. These were assumed to be the same for all children and covariance between children were assumed to be negligible. Contrasts at specific earlier time points are presented in earlier publications.[11-16]

[b] Based upon self-report

Arrest-related outcomes were based upon self-report combined with maternal and other-caregiver report (when available)

[c] Survival rate at age 18 from Cox proportional hazard model

[d] Based upon both self-report for all substances, and urine assays for specific substances - PCP, benzodiazepines, cocaine, amphetamines, THC, opiates, and barbiturates.

[e] Internalizing problems were based upon youth self-report at ages 12 and 18, and maternal/other caregiver report at child age 6, indicated by values exceeding the borderline/clinical threshold.

[f] Ages 6, 12, and 18

[g] Externalizing and total problems were based upon reports in which mothers/other caregivers (age 6); mothers/other caregivers, teachers, and children (2 of 3 at age 12); and youth and mothers/other caregivers (age 18) reported scores that exceeded the borderline/clinical threshold.

[h] LS Mean = Least Squares (adjusted) mean
[i] ES = Effect Size (effect expressed in standard deviation units)
[j] AOR = Adjusted Odds Ratio
[k] IR = Incidence Ratio
[l] HR = Hazards Ratio
(*) P<.10

Supplement Table 1. No Covariate Model Estimates of youth's cognitive, language, academic, executive functioning and Supplemental Social Security Benefit received among 18-year old youth in intervention and control conditions [a]

			Control (T2)		Nurse Visited (T4)		T4-T2	
Variable	**Group**	**Age at Assessment [b]**	**N**	**LS-Mean [c] or % (SE)**	**N**	**LS-Mean [c] or % (SE)**	**ES [d] or AOR [e] (95% CI)**	**P-value**
Primary Outcomes								
Nonverbal Intelligence	Whole	18y	431	88.47 (0.62)	192	88.22 (0.93)	-0.02 (-0.21 , 0.17)	0.83
	LPR [f]	18y	227	85.80 (0.86)	106	86.35 (1.25)	0.05 (-0.21 , 0.30)	0.72
	Whole	All [g]	454	88.85 (0.48)	204	89.33 (0.72)	0.04 (-0.10 , 0.18)	0.58
	LPR [f]	All [g]	237	86.58 (0.66)	111	87.61 (0.97)	0.09 (-0.11 , 0.28)	0.38
Receptive Language	Whole	18y	427	81.95 (0.70)	194	81.94 (1.04)	-0.00 (-0.18 , 0.17)	0.99
	LPR [f]	18y	223	78.03 (0.97)	108	80.57 (1.39)	0.18 (-0.06 , 0.42)	0.14
	Whole	All [g]	454	82.41 (0.58)	204	82.92 (0.86)	0.04 (-0.11 , 0.18)	0.62
	LPR [f]	All [g]	237	78.93 (0.79)	111	81.00 (1.16)	0.15 (-0.05 , 0.34)	0.14
Math achievement score	Whole	18y	428	80.57 (0.59)	193	82.03 (0.88)	0.12 (-0.05 , 0.29)	0.17
	LPR [f]	18y	225	77.73 (0.81)	108	81.85 (1.17)	0.34 (0.11 , 0.57)	0.004 **
	Whole	All [h]	454	85.40 (0.48)	205	86.34 (0.71)	0.08 (-0.06 , 0.22)	0.27
	LPR [f]	All [h]	237	82.44 (0.66)	111	85.82 (0.97)	0.28 (0.09 , 0.47)	0.004 **
Secondary Outcomes								
Sustained Attention	Whole	18y	432	8.71 (0.13)	194	8.74 (0.19)	0.01 (-0.15 , 0.17)	0.91
	LPR [f]	18y	227	8.20 (0.18)	108	8.47 (0.26)	0.09 (-0.13 , 0.31)	0.41
	Whole	All [i]	443	8.71 (0.12)	199	8.63 (0.18)	-0.03 (-0.18 , 0.12)	0.70
	LPR [f]	All [i]	232	8.43 (0.17)	110	8.43 (0.24)	0.00 (-0.20 , 0.20)	0.99
Working Memory Index	Whole	18y	432	8.37 (0.13)	194	8.62 (0.19)	0.09 (-0.07 , 0.26)	0.27
	LPR [f]	18y	227	7.82 (0.17)	108	8.35 (0.25)	0.20 (-0.02 , 0.43)	0.08 (*)
Emotion Recognition – no. correct	Whole	18y	427	52.65 (0.40)	190	53.68 (0.61)	0.12 (-0.05 , 0.29)	0.16
	LPR [f]	18y	225	51.69 (0.55)	104	53.47 (0.82)	0.21 (-0.02 , 0.45)	0.07 (*)

			Control (T2)		Nurse Visited (T4)		T4-T2	
Variable	**Group**	**Age at Assessment [b]**	**N**	**LS-Mean [c] or % (SE)**	**N**	**LS-Mean [c] or % (SE)**	**ES [d] or AOR [e] (95% CI)**	**P-value**
Risky Decision Making	Whole	18y	430	5.19 (0.19)	193	4.97 (0.29)	-0.06 (-0.23 , 0.11)	0.52
	LPR [f]	18y	227	5.09 (0.26)	107	5.10 (0.39)	0.00 (-0.23 , 0.23)	0.98
High School Graduation %	Whole	18y	431	71.4% (2.19%)	188	74.4% (3.27%)	1.17 (0.79 , 1.74)	0.44
	LPR	18y	227	69.6% (3.05%)	106	68.9% (4.50%)	0.97 (0.59 , 1.59)	0.89
Graduate with Honors % [j]	Whole	18y	431	5.4% (1.16%)	188	10.2% (2.22%)	1.99 (1.04 , 3.81)	0.04 *
	LPR	18y	227	3.1% (1.15%)	106	8.5% (2.71%)	2.92 (1.06 , 8.06)	0.04 *
SSI Disability-% [j]	Whole	18y	429	6.9% (1.38%)	190	4.5% (1.55%)	0.64 (0.28 , 1.45)	0.27
	LPR [f]	18y	226	13.3% (2.26%)	104	5.8% (2.29%)	0.40 (0.16 , 0.99)	0.03 *

[a] The estimates of intervention-control differences averaged over all other fixed classification variables, including those within subjects, and the same treatment effect restricted to the group defined by LPR. This table shows the least squares means at 18 years and repeated measures over time (labeled All under Age at Assessment), which also are averaged over other fixed classification effects. For estimates of treatment effects based upon repeated measures, we assumed an error structure with different variances at each time for a given child and different covariance between pairs of times within each child. These were assumed to be the same for all children and covariance between children were assumed to be negligible. Contrasts at specific earlier time points are presented in earlier publications.[10-15]

[b] Age at Assessment: Age 18 assessment denoted by 18y; repeated measures assessment denoted by All. The exact ages aggregated for repeated measures estimates are given in footnotes below.

[c] LS Mean = Least Squares (adjusted) mean

[d] ES = Effect Size (expressed in standard deviation units)

[e] AOR = Adjusted Odds Ratio

[f] LPR = Subgroup defined by youths' mothers falling into the lower half of the distribution for psychological resources (limited psychological resources)

[g] Ages 6 and 18

[h] Ages 6, 12 and 18

[i] Ages 12 and 18

[j] Exploratory outcome

(*) P<.10

* P<.05

** P<.01

Supplement Table 2. No Covariate Model Estimates of youths' substance-use disorders, drug or alcohol use, STI's, pregnancies, births, behavioral problems, arrests, convictions, and gang activity [a]

			Control (T2)		Nurse Visited (T4)		T4-T2	
Variable	Group	Age at Assessment	N	LS-Mean [h] or % (SE)	N	LS-Mean [h] or % (SE)	ES [i] or AOR [j] or IR [k] or HR [l] (95% CI)	P-value
Primary Outcomes								
Time to Substance Use Disorder % [b, c]	Whole	18y	435	11.3% (1.44%)	194	13.7% (2.25%)	1.23 (0.82 , 1.85)	0.32
Current drug use SR past month or positive lab test % [d]	Whole	18y	423	48.2% (2.43%)	190	51.6% (3.63%)	1.14 (0.81 , 1.61)	0.44
Time to First Pregnancy % [b, c]	Males	18y	210	18.2% (2.58%)	95	15.6% (3.36%)	0.84 (0.50 , 1.42)	0.52
	Females	18y	225	26.6% (2.88%)	99	24.3% (4.06%)	0.90 (0.58 , 1.40)	0.65
Time to First Live Birth % [b, c]	Males	18y	210	6.9% (1.65%)	95	8.0% (2.45%)	1.17 (0.57 , 2.40)	0.67
	Females	18y	225	16.8% (2.42%)	99	14.3% (3.28%)	0.84 (0.49 , 1.46)	0.54
Any positive STI lab test %	Males	18y	198	15.7% (2.58%)	88	14.8% (3.78%)	0.93 (0.46 , 1.89)	0.85
	Females	18y	220	23.2% (2.85%)	99	26.3% (4.42%)	1.18 (0.68 , 2.04)	0.55
HIV Risk (log-transformed)	Whole	18y	417	-13.51 (0.17)	187	-13.68 (0.26)	-0.05 (-0.22 , 0.12)	0.58
Internalizing Behavior Problems % [e, f]	Whole	18y	431	18.0% (1.95%)	194	17.1% (2.83%)	0.94 (0.59 , 1.50)	0.78
	Whole	All [f]	459	20.8% (1.35%)	207	17.9% (1.86%)	0.83 (0.62 , 1.12)	0.23
No. Arrests [b]	Whole	18y	435	0.36 (0.05)	194	0.39 (0.08)	1.09 (0.65 , 1.80)	0.75
	Females	18y	225	0.24 (0.05)	99	0.22 (0.07)	0.94 (0.44 , 2.02)	0.88
No. Convictions [b]	Whole	18y	435	0.28 (0.04)	194	0.27 (0.06)	0.97 (0.57 , 1.64)	0.90
	Females	18y	225	0.21 (0.04)	99	0.12 (0.04)	0.58 (0.25 , 1.34)	0.20
No. Interpersonal Violence Arrests [b]	Whole	18y	435	0.14 (0.03)	194	0.20 (0.05)	1.44 (0.76 , 2.72)	0.26

			Control (T2)		Nurse Visited (T4)		T4-T2	
Variable	Group	Age at Assessment	N	LS-Mean [h] or % (SE)	N	LS-Mean [h] or % (SE)	ES [i] or AOR [j] or IR [k] or HR [l] (95% CI)	P-value
	Females	18y	225	0.10 (0.03)	99	0.15 (0.06)	1.55 (0.60 , 4.00)	0.36
No. Interpersonal Violence Convictions [b]	Whole	18y	435	0.10 (0.02)	194	0.15 (0.04)	1.42 (0.71 , 2.81)	0.32
	Females	18y	225	0.09 (0.03)	99	0.08 (0.04)	0.91 (0.32 , 2.61)	0.86
Ever in gang % [b]	Whole	18y	432	10.9% (1.50%)	193	14.5% (2.54%)	1.39 (0.84 , 2.30)	0.20
Secondary Outcomes								
Externalizing Behavior Problems % [g]	Whole	18y	424	7.6% (1.33%)	187	8.6% (2.14%)	1.15 (0.60 , 2.20)	0.67
	Whole	All [f]	459	14.4% (1.21%)	206	14.9% (1.82%)	1.04 (0.74 , 1.46)	0.83
Total Behavior Problems % [f, g]	Whole	18y	424	4.5% (1.04%)	187	7.2% (1.97%)	1.64 (0.77 , 3.45)	0.20
	Whole	All [f]	459	8.4% (0.96%)	206	8.1% (1.53%)	0.96 (0.60 , 1.53)	0.86

[a] The estimates of intervention-control differences averaged over all other fixed classification variables, including those within subjects, and the same treatment effect restricted to the group defined by females for arrest and conviction outcomes. This table shows the least squares means at 18 years and repeated measures over time, which also are averaged over other fixed classification effects. For estimates of treatment effects based upon repeated measures (labeled All under Age at Assessment), we assumed an error structure with different variances at each time for a given child and different covariance between pairs of times within each child. These were assumed to be the same for all children and covariance between children were assumed to be negligible. Contrasts at specific earlier time points are presented in earlier publications.[10-15]

[b] Based upon self-report
Arrest-related outcomes were based upon self-report combined with maternal and other-caregiver report (when available)

[c] Survival rate at age 18 from Cox proportional hazard model

[d] Based upon both self-report for all substances, and urine assays for specific substances - PCP, benzodiazepines, cocaine, amphetamines, THC, opiates, and barbiturates.

[e] Internalizing problems were based upon youth self-report at ages 12 and 18, and maternal/other caregiver report at child age 6, indicated by values exceeding the borderline/clinical threshold.

[f] Ages 6, 12, and 18

[g] Externalizing and total problems were based upon reports in which mothers/other caregivers (age 6); mothers/other caregivers, teachers, and children (2 of 3 at age 12); and youth and mothers/other caregivers (age 18) reported scores that exceeded the borderline/clinical threshold.

[h] LS Mean = Least Squares (adjusted) mean

[i] ES = Effect Size (effect expressed in standard deviation units)

[j] AOR = Adjusted Odds Ratio

[k] IR = Incidence Ratio

[l] HR = Hazards Ratio