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Effects of Home Visits by Paraprofessionals and by Nurses on Children: Age-Six and Nine Follow-Up of a Randomized Trial

David L. Olds, Ph.D.^a, John R. Holmberg, Psy. D.^a, Nancy Donelan-McCall, Ph.D.^a, Dennis W. Luckey, Ph.D.^b, Michael D. Knudtson, MS^a, and JoAnn Robinson, Ph.D.^c

^aUniversity of Colorado Denver, Department of Pediatrics, School of Medicine

^bUniversity of Colorado Denver, Department of Biostatistics and Informatics, Colorado Public School of Health

^cUniversity of Connecticut, Department of Human Development and Family Studies

Abstract

Objective—To examine the impact of prenatal and infancy/toddler home visiting by paraprofessionals and by nurses on child development at child ages 6 and 9.

Design—Randomized controlled trial.

Setting—Public and private care settings in Denver, Colorado.

Participants—735 low-income women and their first-born children; 85% of the mothers were unmarried, 47% Hispanic, 35% non-Hispanic white, 15% African-American, and 3% American Indian/Asian.

Interventions—Home visits provided from pregnancy through child age 2 delivered in one group by paraprofessionals and in the other by nurses.

Primary Outcomes—Reports of children's internalizing, externalizing, and total emotional/behavioral problems; tests of children's language, intelligence, attention, attention dysfunction, visual attention/task shifting, working memory, and academic achievement. We hypothesized that program effects on cognitive related outcomes would be more pronounced among children born to mothers with low psychological resources. We report paraprofessional-control and nurse-control differences with p-values <.10 given similar effects in a previous trial, earlier impacts in this trial, and limited statistical power.

Correspondence: David L. Olds, Ph.D. University of Colorado Denver 13121 East 17th Avenue, Mail Stop 8410 Aurora, CO 80045 phone: 303-724-2892; fax: 303-724-2901 David.Olds@UCDenver.edu.

Author Contributions: *Study concept and design:* Olds and Robinson. *Acquisition of data:* Holmberg and Robinson. *Analysis and interpretation of data:* Donelan-McCall, Luckey, Knudtson, Olds, Holmberg. *Drafting the manuscript:* Olds, Holmberg, Donelan-McCall. *Critical revision of manuscript for important intellectual content:* Olds, Holmberg, Luckey, Knudtson, Donelan-McCall, Robinson. *Statistical analysis:* Luckey, Knudtson. *Obtained funding:* Olds. *Study supervision:* Olds, Holmberg, Robinson.

Conflict of Interest Disclosures None of the authors has a personal financial interest in the Nurse-Family Partnership. The Prevention Research Center for Family and Child Health, 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. DWL, JRH, NDM, MDK, JR, and DLO were employed by this center at the time the study was conducted. Olds is the founder of the Nurse Family Partnership. Donelan-McCall is conducting research and education for NFP nurses regarding the promotion of early parental care-giving.

Results—There were no significant paraprofessional effects on emotional/behavioral problems, but paraprofessional-visited children born to mothers with low psychological resources, compared to control group counterparts, exhibited fewer errors in visual attention/task switching at age 9 (ES=-0.30, p=.078). There were no statistically significant paraprofessional effects on other primary outcomes.

Nurse-visited children were less likely to be classified as having total emotional/behavioral problems at age 6 (RR=0.45, p=.082), internalizing problems at age 9 (RR=0.44, p=.078), and dysfunctional attention at age 9 (RR=0.34, p=.070). Nurse-visited children born to low-resource mothers, compared to control-group counterparts, had better receptive language averaged over ages 2, 4, and 6 (ES = 0.30, p=.014), and sustained attention averaged over ages 4, 6, and 9 (ES = 0.36, p =.006). There were no significant nurse effects on externalizing problems, intellectual functioning, and academic achievement.

Conclusions—Children born to low-resource mothers visited by paraprofessionals exhibited improvement in visual attention/task switching. Nurse-visited children showed improved behavioral functioning, and those born to low-resource mothers benefited in language and attention, but did not improve in intellectual functioning and academic achievement.

Keywords

nurse; paraprofessional; home visits; child development; language; achievement; attention; behavioral problems

Home visiting by nurses for low-income, at risk families has been promoted as an evidence-based strategy for improving the health and development of first-born children from low-income families.^{1,2} Three randomized controlled trials of a program known as the Nurse-Family Partnership (NFP) conducted in Elmira, NY (with a primarily white sample),³⁻⁶ Memphis, TN (with a low-income African American sample),⁷⁻¹¹ and Denver CO (with a large portion of Latina mothers),^{12,13} found replicated and enduring effects in at least two of the three trials on prenatal health,^{3,7,12} child health and development,^{4,5,7,9,10,11,12,13} and maternal life-course.^{6,7-9,12,13} These trials have served as the primary evidentiary foundation for the Maternal Infant and Early Childhood Home Visiting program funded under the Affordable Care Act.¹⁴

The Denver NFP trial was designed to examine the impact of the program model when delivered by paraprofessional visitors who shared many of the social characteristics of the families they visited, and to estimate the impact of the program with a sample that included a large portion of Latino families. Through child age 4, we found that the nurse-delivered version of the NFP in Denver produced effects on child development^{12,13} that were essentially limited to children born to mothers with low psychological resources. The moderation of program effects by mothers' psychological resources replicated a pattern found in Memphis.⁹⁻¹¹ The benefits of the paraprofessional delivered program estimated in earlier phases of the Denver trial were smaller and more sporadic.^{12,13} This paper reports the results of two waves of follow-up of children in the Denver trial at ages 2 and 9.

We hypothesized that nurse-visitors in the current trial would produce effects like those in earlier phases of this trial,^{12,13} and like those in Memphis.⁹⁻¹¹ We hypothesized that

program effects on children's cognitive related outcomes (including dysregulated aggression and incoherent responses to story stems) would be limited to children born to mothers with low psychological resources, and that program effects on children's emotional and behavioral problems would be present irrespective of their mothers' psychological resources.^{9,11} In Memphis, program effects on emotional and behavioral problems were expressed in reductions in children's total behavioral problems at age six and in internalizing problems at age 12 using the Child Behavioral Check List;^{9,11} a different measure was used to assess behavioral problems at age 9.¹⁰ Given previous trials of paraprofessional home-visitor programs¹⁵⁻¹⁶ and earlier results from this trial,^{12,13} we expected paraprofessionals to produce fewer and smaller effects than those produced by nurses.

Methods

The current study consisted of a follow-up of children at around the child's 6th and 9th birthdays. The major features of the design have been reported earlier^{5,7} and are summarized here.

Participants

From March 1994 through June 1995, 1178 consecutive women, from 21 antepartum clinics serving low-income women in Denver, were invited to participate in the study by research interviewers after being referred by clinic staff. Women were recruited if they had no previous live births and either qualified for Medicaid or had no private health insurance. Medicaid eligibility in Colorado at the time was extended to pregnant women with incomes at or below 133% of the federal poverty guidelines. The numbers of women and their children invited to participate, randomized, and assessed at the 6- and 9-year follow-ups are delineated in eTable 1, eAppendix. The study was approved by the Colorado Multiple Institutional Review Board.

Randomization

After completion of baseline interviews, interviewers sent information on participants to a separately located data-operations office where it was entered into a computer program that randomized women to treatment conditions.¹⁷ Randomization was conducted within strata from a model with three classification factors: maternal race/ethnicity (Hispanic, Anglo non-Hispanic, African-American, American Indian/Asian), maternal gestational age at enrollment (<32 vs. 32+ weeks), and geographic region of residence (4 regions). Women assigned to one of the two home-visitor groups subsequently were assigned at random to home visitors responsible for their geographic region.

Treatment Conditions

Women in Treatment 1 (n = 255) were provided free developmental screening and referral for their child at 6, 12, 15, 21, and 24 months of age. Women in Treatment 2 (n = 245) were provided the screenings offered Treatment 1 plus paraprofessional home-visiting during pregnancy and the child's first 2 years of life. Women in Treatment 3 (n = 235) were provided the screening offered Treatment 1 plus nurse home-visiting during pregnancy and the child's first 2 years. At each post-intervention phase of follow-up (child ages 4, 6, and 9),

children with developmental needs were referred for further evaluation and treatment through existing community services.

Design and Implementation of Home-Visit Programs

The paraprofessional- and nurse-delivered programs were augmented versions of the core nurse-delivered program carried out in Elmira and updated in Memphis.^{17,18} The NFP has 3 goals: 1) to improve outcomes of pregnancy by helping women improve their health-related behaviors; 2) to improve children's subsequent health and development by helping parents provide competent care of their children; and 3) to enhance mother's personal development by promoting planning of future pregnancies and helping women continue their educations and find work. Nurse home visitors were required to have a BSN degree with experience in community or maternal and child health nursing; paraprofessionals were required to have a high school education and no college preparation in the helping professions.¹⁹

Assessments and Definitions of Variables

Assessments for this follow-up were conducted at child ages 6 and 9, with mean child ages at assessment of 78.1 months (SD=3.2) and 118.8 months (SD=3.1). The assessments were carried out from March 2001 through February 2006, by interviewers and child evaluators masked to participants' treatment. The assessments were based upon interviews, observations, and psychological tests with the children, and mothers' and teachers' reports of children's behavior. Previous assessments were conducted by research staff at the time of registration (prior to their assignment to treatments), at the 28th and 36th weeks of pregnancy, and at the 6th, 12th, 15th, 21st, 24th, and 48th months of the child's life.

Baseline Assessments—Baseline assessments have been described in previous reports.^{12,13} A variable was created to form an index of mothers' psychological resources based upon the summed z-scores of women's: 1) intelligence,²⁰ 2) mental health,²¹ and 3) sense of mastery.²² In order to be consistent with the psychological resource classification used in the Memphis trial, we dichotomized the sample at the exact raw-score values used in Memphis to dichotomize the variable at the sample median. In Denver, this split the sample into low (40%) and high (60%) resource groups. For the current report, we geocoded neighborhoods in which families lived at registration and created a neighborhood adversity score indexed in standard deviation units around the national mean for adversity.²³

Primary Outcomes: Behavioral Problem Domain—These outcomes consisted of norm-referenced measures of internalizing, externalizing, and total behavioral problems based upon teacher and parent report of behavioral problems in which both reporters gave scores that put the children in the borderline or clinical ranges;^{24, 25} and children's scores on the Conners Continuous Performance Test²⁶ that placed them in the dysfunctional attention/impulsive range.²⁷

Primary Outcomes: Cognitive Domain—These outcomes were derived from norm-referenced tests of receptive language,^{28, 29} and intellectual functioning³⁰ at age 6; sustained attention³¹ at ages 6 and 9; reading and math achievement at ages 6³⁰ and 9;³²

and executive cognitive functioning (visual attention/task switching - Trails B,³³ and working memory³⁴) at age 9.

Secondary Outcomes—Secondary outcomes were measured to augment the interpretation of the primary outcomes. They consisted of: children's narrative responses to the MacArthur Story Stem Battery (MSSB) coded to characterize the degree of dysregulated aggression and incoherence revealed in their stories;³⁵ evaluators' ratings of children's behavioral regulation during testing;³¹ mothers' reports of their children's receipt of specific therapeutic services (for speech and language problems, cognitive delays, attention deficit and hyperactivity, emotional problems -- both prior to the age-6 interview, and between ages 6 and 9), whether their children had been retained in school, and whether they had received special education or remedial services in the first 3 years of elementary school.

Statistical Models and Methods of Analysis

Data analyses were conducted on all cases randomized insofar as outcome data were available (intention to treat). The primary statistical model consisted of a single classification factor for treatment (3 levels), 6 baseline covariates (maternal psychological resource index, smoking status, whether mothers registered in the study after 28 weeks of gestation, housing density, maternal conflict with her mother/mother figure, and neighborhood disadvantage) to adjust for treatment non-equivalence ($p < .10$) among participants assessed at either the 6- or 9-year follow-ups, plus 2 additional covariates (child age at assessment and gender). This core model was examined for the sample as a whole and separately for children born to high - and low -resource mothers. Continuous dependent variables were examined in the general linear model,³⁶ with mean differences converted to Effect Sizes; dichotomous outcomes were examined in a modified Poisson regression,³⁷ with differences in rates converted to Relative Risks (RR).

Estimates and tests were adjusted for all covariates, which were examined for homogeneity of regressions.³⁸ We employed pared down versions of this model when outcomes were infrequently occurring; the tables specify these reduced models. Tests focused on Paraprofessional versus Control and Nurse versus Control contrasts. Details of the statistical methods are presented in the eAppendix.

Tables show exact probability levels for individual contrasts of each of the visited groups with controls (for 2-tailed tests) and 95% confidence intervals for treatment contrasts. At the stage of study design, we estimated that we could detect reductions in total behavioral problems from 8.5% to 2.4% for the sample as a whole, and Effect Sizes of 0.33 on normally distributed outcomes for children born to low-resource mothers, assuming $\alpha = .05$, $\beta = .20$, and 2-tailed tests. We did not adjust for multiple comparisons.

We discuss treatment-control differences with p-values $< .10$ (essentially one-tailed tests with $p < .05$) because we have corresponding outcomes and estimates of treatment effects of similar magnitude for nurse-control contrasts that were statistically significant at $p < .05$ in the Memphis trial (which had a control group twice as large as the Denver trial). For outcomes in the cognitive domain and secondary outcomes, we show effects only for children born to low-resource mothers, given corresponding effects in Memphis and earlier

phases of the current trial. We give results for children born to mothers with high psychological resources in the eAppendix, and note in the text when treatment differences were present for the high-resource group at $p < .05$, as they were not hypothesized.

Results

Sample Retention

Direct assessments were conducted on 81% of the children at age 6 and 78% at age 9 using as a denominator all cases originally randomized (90% and 89% of those cases in which the child was alive, not adopted, or the parent had not declined participation at earlier follow-up phases). Rates of retention were similar across treatment conditions (eTable 1, eAppendix).

Equivalence of Treatment Conditions

Participants in the 6- and 9-year follow-ups were similar on background characteristics across treatment conditions, both for the sample overall and for the group defined by mothers' having low psychological resources (eTable 2, eAppendix).

Paraprofessional Effects

Primary Outcomes: Behavioral Problem Domain—Table 1 shows that there were no statistically significant paraprofessional-control differences in children's internalizing, externalizing, or total behavioral problems, or dysfunctional attention.

Primary Outcomes: Cognitive Domain—Table 2 shows that paraprofessional-visited children born to mothers with low psychological resources, compared to control group counterparts, made fewer errors on the test of visual attention and task shifting at age 9 ($ES = -0.30$, $p = .078$). There were no significant paraprofessional effects on children's working memory, receptive language, intellectual functioning, or reading and math achievement. Paraprofessional visited children born to higher resource mothers had lower sustained attention than their control-group counterparts, both over the 4–9 year period, and at the 9-year assessment ($ES = -0.21$, $p = .031$, and $ES = -0.26$, $p = .035$, respectively), eTable 3, eAppendix.

Secondary Outcomes—Table 3 shows that paraprofessional visited children born to low-resource mothers, compared to control-group counterparts, exhibited less dysregulated aggression ($ES = -0.36$, $p = .023$) and fewer incoherent stories ($ES = -.050$, $p = .002$) in response to the MSSB, and better behavioral regulation during testing ($ES = 0.32$, $p = .05$). However, paraprofessional-visited children born to high-resource mothers had more incoherent stories than their control-group counterparts ($ES = 0.38$, $p = .004$), eTable 4, eAppendix. Paraprofessional-visited children born to low-resource mothers were less likely to have used therapeutic services prior to the 6-year interview ($RR = 0.63$, $p = .070$). There were no significant paraprofessional-control differences in children's use of special education/remedial services or grade retention in the first three years of elementary school.

Nurse Effects

Primary Outcomes: Behavioral Problem Domain—Table 1 shows that nurse-visited children were less likely to have been classified as having total emotional/behavioral problems at age 6 (RR=0.45, p=.082), internalizing problems at age 9 (RR=0.44, p=.078), and dysfunctional attention at age 9 (RR=0.34, p=.070). There were no statistically significant nurse effects on total behavioral problems at age 9, internalizing problems at age 6, and externalizing problems at either age.

Primary Outcomes: Cognitive Domain—Table 2 shows that nurse-visited children born to low-resource mothers, compared to their control-group counterparts, had better receptive language scores averaged over ages 2, 4, and 6 (ES=0.30, p=.014), although the difference at age 6 was not statistically significant (ES=0.21, p=.161). They also had better sustained attention averaged over ages 4, 6, and 9 (ES=0.36, p=.006), at age 6 (ES=0.33, p=.048), and at age 9 (ES=0.33, p=.075). There were no statistically significant nurse effects on children's visual attention/task switching, working memory, intellectual functioning, or academic achievement.

Secondary Outcomes—Table 3 shows that there were no significant nurse effects on dysregulated aggression in response to the MSSB, or evaluators' ratings of behavioral regulation. Contrary to expectation, nurse-visited children born to high-resource mothers had higher rates of incoherent stories at age 6 than their control-group counterparts (ES=0.32, p=.012), eTable 4, eAppendix.

At age 6, nurse-visited children born to low-resource mothers were less likely to have used therapeutic services (RR=0.46, p=.011), and to have been enrolled in special education or remedial services in the first 3 years of elementary school (RR=0.57, p=.061). The difference in use of therapeutic services was not significant in the age-6-to-9-year period.

Moderation of Program Effects by Neighborhood Adversity—We examined the extent to which program effects on children were more pronounced among those with the dual risks of having mothers with low psychological resources and living in more disadvantaged neighborhoods at registration during pregnancy. The nurse (but not paraprofessional) effects on child cognition, language, and achievement were more pronounced among children born to mothers with low psychological resources and who lived in the most disadvantaged neighborhoods, but the number of cases living in the most disadvantaged neighborhoods was small, introducing instability in estimates (data not shown).

Comment

Paraprofessional-visited children born to low-resource mothers had fewer errors on the test of visual attention/task shifting at age 9; exhibited better behavioral regulation during the age-6 assessment; had fewer incoherent stories and dysregulated/ aggressive themes in their responses to the MSSB; and used fewer therapeutic services prior to the 6-year assessment. The paraprofessional-control differences in behavioral regulation, use of services, and visual attention are internally consistent, and the treatment effects in dysregulated aggression and

incoherent story stem narratives align with corresponding nurse effects in the Memphis trial.⁹

Nurse-visited children were less likely to be classified as having total behavioral problems at age 6, internalizing disorders at age 9, and dysfunctional attention at age 9. These behavioral problem findings are consistent with corresponding nurse effects in Memphis at ages 6 (for total problems)⁹ and 12 (for internalizing problems),¹¹ and with earlier nurse effects on sustained attention and executive functioning in the current trial.¹³ Nurse-visited children born to low-resource mothers had better language functioning aggregated through age 6, and attention through age 9, but exhibited no statistically significant benefits in cognition and reading and math achievement as found in Memphis.^{9,10, 11}

In correspondence with their better language and attention scores in early childhood^{12, 13} and at school entry, nurse-visited children born to low-resource mothers used fewer therapeutic services prior to age-six, and were enrolled less frequently in special education or remedial services during their first three years of elementary school. There were no statistically significant nurse effects on children's intellectual functioning, math and reading achievement, and dysregulated/aggressive themes in children's response to the MSSB as we had observed in Memphis.^{9,10} There are five possible, non-exclusive explanations for the absence of nurse effects on these outcomes:

- 1) The nurse-delivered program simply loses impact over time. Given significant enduring effects in the cognitive domain for children born to low-resource mothers in the Memphis trial, it is unlikely that the story is as simple as this.
- 2) The benefit of the nurse-delivered program for children born to low-resource mothers is most pronounced for families living in highly disadvantaged neighborhoods. Neighborhood disadvantage is a marker for adversity and toxic stress, which is associated with damaged executive functioning, language, and behavioral regulation among children unless parents are equipped to protect them.³⁹ The mean level of neighborhood adversity in Memphis, for example, was 2.4 SD above the national mean, substantially more disadvantaged than neighborhoods of participants in the Denver trial (0.4 SD above the national mean). The greater enduring impact of the program on cognition and achievement among children born to low-resource mothers in the Memphis trial therefore is likely a reflection, at least in part, of the greater number of stressors experienced by Memphis children that, without parental protection, damaged their development to a greater degree than their Denver counterparts who lived in lower adversity contexts. While the nurse-control differences in language and cognition among children born to mothers with low psychological resources were most pronounced among those who lived in the most disadvantaged neighborhoods in Denver, the number of cases living in highly disadvantaged neighborhoods was too small to make stable estimates of program impacts in those contexts.
- 3) The benefit of the program is greatest where there is greater room for improvement. Control group children born to low-resource mothers in the

Denver trial had mean Mental Processing (IQ) scores at age 6 of 94.85 compared to 87.64 for their counterparts in Memphis, about a half standard deviation difference. It is likely that these differences in cognition across trials reflect differences in early experience that to some degree are alterable by the program through its support of parents' efforts to protect their children. Program impact on child cognition and achievement appears to be reduced among those with normative levels of cognitive functioning.

- 4) The relative benefit of the program for children born to low-resource mothers declines to the extent that children obtain therapeutic services that address their developmental needs. By age 6, control group children born to low-resource mothers were more likely to receive therapeutic services for problems with language, cognition, and behavior than their nurse-visited counterparts; and they were enrolled more frequently in special education and remedial services once they entered elementary school. It is reasonable to assume that if such services are of high quality and parents are engaged, the receipt of those services will lead to improvements in child functioning and attenuation of NFP impact.
- 5) The absence of statistically significant effects on some cognitive and socio-emotional outcomes is a reflection of limited statistical power. In Memphis, statistically significant program effects were found on language and achievement test scores at child ages 6 and 9 that were in the 0.22– 0.25 SD range for children born to low-resource mothers. Effects of similar magnitude in the current trial were not even statistical trends ($p > .10$). The difference between trials is probably due in part to the Memphis trial's having a control group that was twice as large as its counterpart in Denver, and to its having a larger proportion of families defined by mothers having low psychological resources.⁷

The findings reported here must be interpreted in light of two additional limitations: First, we had lower rates of completed behavioral assessments among teachers than among parents. It is better, however, to measure behavioral problems from two reporters rather than one, as this increases validity.²⁵ Second, the pattern of statistically significant effects and trends must be interpreted in the context of our having conducted statistical tests with multiple outcomes.

As the NFP is replicated and tested in new RCT's throughout the US and other societies, it will be important to determine whether it is particularly successful in reducing disparities in health, achievement, and economic productivity among children born to mothers who have limited psychological resources and who are living in severely disadvantaged neighborhoods, as this will enable policy makers to focus NFP resources where they produce the greatest benefit.

Finally, the findings from this trial suggest that if we are going to improve the life chances of our most vulnerable children, we must shift public policy toward investments in a range of complementary interventions early in life that have strong evidentiary foundations and capacities for quality implementation.^{1, 40–42}

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

(CBCL)	Child Behavior Checklist
(KABC)	Kaufman Assessment Battery for Children
(MSSB)	MacArthur Story Stem Battery
(PIAT)	Peabody Individual Achievement Test
(PPVT)	Peabody Picture Vocabulary Test
(TRF)	Teacher Report Form

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Table 1

Primary Outcomes: Behavioral Problems Domain – Whole Sample

Dependent Variable	Time	Treatment Group						Treatment Comparisons					
		Control		Paraprofessional		Nurse		Paraprofessional – Control		Nurse - Control		p-value	
		N	%	N	%	N	%	Relative Risk (95% CI)	p-value	Relative Risk (95% CI)	p-value	Relative Risk (95% CI)	p-value
Total Problems (borderline/clinical) ^a	6 yrs	176	7.8	173	8.1	169	3.5	1.04 (0.52 to 2.09)	0.908	0.45 (0.18 to 1.15)	0.082		
	9 yrs	164	9.6	153	9.3	138	7.2	0.97 (0.50 to 1.90)	0.940	0.76 (0.36 to 1.61)	0.464		
Internalizing Problems (borderline/clinical) ^a	6 yrs	176	2.7	173	3.7	169	1.1	1.35 (0.44 to 4.14)	0.596	0.42 (0.08 to 2.15)	0.280		
	9 yrs	164	8.2	153	7.8	138	3.6	0.96 (0.46 to 1.97)	0.904	0.44 (0.16 to 1.18)	0.078		
Externalizing Problems (borderline/clinical) ^a	6 yrs	176	10.1	173	8.7	169	7.6	0.87 (0.46 to 1.63)	0.658	0.76 (0.38 to 1.50)	0.423		
	9 yrs	165	10.2	155	13.7	138	6.6	1.34 (0.74 to 2.43)	0.332	0.64 (0.30 to 1.40)	0.249		
Attention Dysfunction ^b	9 yrs	187	5.3	177	2.8	166	1.8	0.53 (0.18 to 1.52)	0.222	0.34 (0.09 to 1.21)	0.070		

^a Achenbach 23 scores from both parents (CBCL) and teachers (TRF) that cross the borderline or clinical threshold; covariate: maternal psychological resource index

^b Conners 25 Continuous Performance Test - Clinical Confidence Index (scores that exceed values of 60); no covariates.

Table 2
 Primary Outcomes: Cognitive Domain – Children Born to Mothers with Low Psychological Resources

	Treatment Group						Treatment Comparisons				
	Control		Paraprofessional		Nurse		Paraprofessional – Control		Nurse – Control		
	N	LSMean (SE)	N	LSMean (SE)	N	LSMean (SE)	Mean Diff (95% CI) Effect Size ^g	p-value	Mean Diff (95% CI) Effect Size ^g	p-value	
Continuous Outcomes	Time Point										
	6 yrs	69	90.56 (1.40)	94	92.59 (1.20)	72	93.31 (1.36)	2.02 (-1.62 to 5.67) 0.16	0.276	2.75 (-1.10 to 6.60) 0.21	0.161
Receptive Language ^a	2, 4, & 6 yrs		89.01 (1.15)		90.90 (0.97)		92.96 (1.09)	1.89 (-1.11 to 4.89) 0.15	0.215	3.95 (0.81 to 7.10) 0.30	0.014
	6 yrs	67	8.32 (0.34)	93	8.71 (0.29)	71	9.28 (0.33)	0.39 (-0.51 to 1.29) 0.13	0.393	0.96 (0.01 to 1.91) 0.33	0.048
Sustained Attention ^b	9 yrs	64	9.17 (0.37)	89	9.25 (0.32)	62	10.12 (0.38)	0.08 (-0.89 to 1.06) 0.03	0.864	0.95 (-0.10 to 2.00) 0.33	0.075
	4, 6, & 9 yrs		8.80 (0.27)		9.21 (0.23)		9.83 (0.26)	0.41 (-0.28 to 1.11) 0.14	0.243	1.04 (0.31 to 1.77) 0.36	0.006
Visual Attention/Task Switching Errors ^c	9 yrs	64	1.16 (0.13)	90	0.84 (0.11)	62	0.89 (0.14)	-0.32 (-0.67 to 0.04) -0.30	0.078	-0.27 (-0.65 to 0.11) -0.25	0.165
	9 yrs	62	5.47 (0.32)	88	5.79 (0.27)	61	6.13 (0.32)	0.32 (-0.53 to 1.17) 0.13	0.461	0.66 (-0.24 to 1.56) 0.26	0.152
Working Memory Errors ^d	6 yrs	69	94.85 (1.30)	97	96.81 (1.10)	72	96.58 (1.28)	1.96 (-1.45 to 5.37) 0.18	0.259	1.73 (-1.90 to 5.35) 0.16	0.349
	6 yrs	69	92.66 (1.48)	95	93.04 (1.26)	72	94.27 (1.44)	0.38 (-3.48 to 4.24) 0.03	0.848	1.61 (-2.48 to 5.70) 0.13	0.439
Arithmetic Achievement Standard Score ^f	9 yrs	66	96.53 (1.48)	90	97.11 (1.27)	62	96.72 (1.50)	0.58 (-3.31 to 4.46) 0.05	0.770	0.19 (-3.97 to 4.35) 0.02	0.929
	6 & 9 yrs		94.60 (1.32)		95.07 (1.12)		95.49 (1.30)	0.48 (-2.98 to 3.94) 0.04	0.786	0.90 (-2.77 to 4.57) 0.07	0.629
Reading Achievement Standard Score ^f	6 yrs	69	93.40 (1.52)	95	96.16 (1.30)	72	95.00 (1.49)	2.76 (-1.22 to 6.74) 0.22	0.173	1.60 (-2.62 to 5.82) 0.13	0.455
	9 yrs	66	94.60 (1.48)	90	97.24 (1.27)	62	97.20 (1.49)	2.64 (-1.25 to 6.53) 0.21	0.182	2.59 (-1.56 to 6.75) 0.21	0.220
6 & 9 yrs		94.00 (1.35)		96.70 (1.14)		96.10 (1.32)	2.70 (-0.83 to 6.23) 0.22	0.133	2.10 (-1.64 to 5.84) 0.17	0.270	

^a PPVT ²⁷ at age 6, Preschool Language Scale ²⁸ receptive language subscale at ages 2 and 4;

^b Letter ³⁰ Sustained Attention Scale;

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^cTrail Making Test Form B 32;

^dDigit Span Task 30;

^eKABC Mental Processing Composite 29 – standard score;

^fPIAT 31;

^gEffect Size = Mean Difference/pooled standard deviation.

Table 3
Secondary Outcomes: Children Born to Mothers with Low Psychological Resources

	Treatment Group						Treatment Comparisons				
	Control		Paraprofessional		Nurse		Paraprofessional – Control		Nurse - Control		
	N	LSMean (SE)	N	LSMean (SE)	N	LSMean (SE)	Mean Diff (95% CI) Effect Size ^d	p-value	Mean Diff (95% CI) Effect Size ^d	p-value	
Continuous Outcomes											
Dysregulated Aggression (MSSB) ^a	68	103.26 (1.29)	94	99.34 (1.10)	72	100.40 (1.25)	-3.92 (-7.30 to -0.54) -0.36	0.023	-2.86 (-6.42 to 0.71) -0.26	0.116	
Percent incoherent stories (MSSB) ^a	68	65.63 (3.70)	94	49.94 (3.16)	72	58.53 (3.60)	-15.69 (-25.41 to -5.97) -0.50	0.002	-7.10 (-17.35 to 3.15) -0.23	0.174	
Behavioral Regulation in Testing ^b	69	97.16 (1.04)	95	99.89 (0.89)	71	99.13 (1.03)	2.74 (-0.00 to 5.47) 0.32	0.050	1.97 (-0.95 to 4.89) 0.23	0.184	
Dichotomous Outcomes											
Any Therapeutic Services ^c	6 yrs	69	35.8	96	22.4	72	16.5	0.63 (0.38 to 1.02)	0.070	0.46 (0.25 to 0.85)	0.011
	9 yrs	66	29.6	89	38.8	61	35.0	1.31 (0.83 to 2.08)	0.233	1.18 (0.72 to 1.94)	0.509
Special Education/Remedial Services ^c	9 yrs	66	33.5	89	32.4	61	19.1	0.97 (0.62 to 1.52)	0.886	0.57 (0.31 to 1.05)	0.061
Grade retention ^c	9 yrs	66	8.5	89	10.7	61	13.0	1.26 (0.50 to 3.19)	0.625	1.53 (0.60 to 3.90)	0.375

^aCoded from children's responses to the MSSB³⁴

^bChild evaluators' ratings³⁰

^cParent report; covariates (maternal psychological resources index, gender, child age at assessment);

^dEffect Size = Mean Difference/pooled standard deviation