Enduring Effects of Prenatal and Infancy Home Visiting by Nurses on Children: Age-12 Follow-Up of a Randomized Trial

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Abstract

Objective—To test, with an urban, primarily black sample, the effect of prenatal and infancy home visits by nurses on 12-year-old first-born children's use of substances, behavioral adjustment, and academic achievement.

Design—Randomized controlled trial.

Setting—Public system of obstetric and pediatric care in Memphis, Tennessee.

Participants—12-year-old first-born children (N=613) of primarily African-American, economically disadvantaged women (N=743 randomized during pregnancy).

Intervention—Program of prenatal and infancy home visits by nurses.

Main Outcome Measures—Use of tobacco, alcohol, and marijuana; internalizing, externalizing, and total behavioral problems; academic achievement.

Results—By the time the first-born child was 12 years of age, those visited by nurses, compared to those in the control group, reported fewer days of having used tobacco, alcohol, and marijuana during the 30-day period prior to the 12-year interview (0.03 versus 0.18, p=.019), and were less likely to report having internalizing disorders that met the clinical/borderline threshold (22% versus 31%, p=.043). Nurse-visited children born to mothers with low psychological resources, compared to control-group counterparts, scored higher on the PIAT achievement tests in reading and math (88.78 versus 85.70, p =.009) and, over their first 6 years of education, scored higher on group-administered standardized tests of math and reading achievement (40.52 versus 34.85, p=.

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023). There were no statistically significant program effects on children's externalizing or total behavioral problems.

Conclusions—Through child age 12, the program reduced children's use of substances and internalizing mental health problems; and improved the academic achievement of children born to mothers with low psychological resources.

Keywords

nurse; home visits; pregnancy; child development; substance use

Home visiting by nurses for low-income, at risk families has been promoted as a means of preventing child abuse and neglect, children's mental health problems, and adolescent crime. [1–3] Much of this interest has stemmed from an adolescent (age 15) follow-up of mothers and children enrolled in the first trial of the Nurse-Family Partnership (NFP) in Elmira, NY, [4–5] with a primarily low-income, white sample.[4,5] We have been conducting a replication trial of the NFP with low-income African Americans living in a major urban area; [6–9] the current study examines the impact of the NFP with this sample at child age 12. This report focuses on the functioning of the children and a companion report focuses on maternal life-course.[10] We hypothesized that the impact of the program on child outcomes would be greater for children born to mothers who had few psychological resources to manage living in poverty and caring well for their children.[11]

Design and Methods

We conducted a randomized controlled trial of the NFP in a public system of obstetric and pediatric care in Memphis, Tennessee, with registration of the original sample completed between June 1990 and August, 1991. Eighty-eight percent (1,139) of the 1,290 eligible women completed informed consent and were randomized to treatment or control conditions. We describe below only those participants who were involved in the postnatal aspect of the trial (N=743).[6] Given high rates of access to the study population for recruitment, and of participant acceptance and retention (described below), the study can be considered an effectiveness trial from the perspective of enrolling and retaining the target population.

We enrolled primarily African-American women <29 weeks gestation, with no previous live births, and with at least 2 sociodemographic risk characteristics (unmarried, <12 years of education, unemployed). Sample size and assignment ratios were derived from statistical power calculations conducted for outcomes in the original phases of the trial. Ninety-two percent of the women enrolled were African-American, 98% were unmarried, 64% were 18 years or younger at registration, and 85% came from households with incomes below the federal poverty guidelines. We randomly assigned participants to receive nurse home visits (n=228) or comparison (control group) services (n=515) following a procedure that concealed randomization from individuals directly involved with study participants. [6]

In the current phase of follow-up after the child's 12th birthday (mean age 12.95 years, SD=0.45), we conducted interviews with mothers (or guardians) and children; assessed

children's sustained attention and academic achievement; abstracted children's school records; and obtained teachers' reports of children's behavior. Table 1 shows the numbers of participants randomized to the two conditions in which follow-up was conducted after the child's birth; lost to follow-up because of death or maternal refusal to participate at earlier phases; and evaluated with parent interviews, child assessments, and reviews of school and state administrative records.

Treatment Conditions

Women in the control group (n = 515) were provided free transportation for scheduled prenatal care plus developmental screening and referral for the child at 6, 12, and 24 months of age. Women in the Nurse-Visited condition (n = 228) were provided the same services as those in the control group, plus prenatal and infancy home visitation through the child's second birthday.

The nurses followed detailed visit-by-visit guidelines but adapted them to the needs of individual families in their efforts to 1) improve the outcomes of pregnancy by promoting women's prenatal health behaviors; 2) improve the health and development of the child by promoting parents' competent care of their children; and 3) enhance parents' life-course development by encouraging parents to plan subsequent pregnancies, complete their education, and find work. The nurses helped families make use of needed health and human services and attempted to involve other family members and friends (particularly the children's fathers and grandmothers) in the pregnancy, birth, and early care of the child.

The program was carried out by the Memphis/Shelby County Health Department during a nursing shortage in which some nurses left the program before the intervention was completed (37% of the visited families had discontinuity in nurse visitors). [6, 11, 12] The nurses carried a maximum of 25 families each and completed a mean of 7 home visits (range: 0–18) during pregnancy and 26 home visits (range: 0–71) during the first 2 years postpartum. This represents about 50% of the 62 visits included in the program, assuming women register at 16 weeks of gestation. The difference between recommended and completed visits is explained in large part by participant attrition from the program. The study is thus close to an effectiveness trial from the standpoint of program implementation. The relationship between program implementation and early outcomes has been reported.[13, 14]

Data Gathering and Child Outcomes

Interviews and assessments of the children were conducted by staff members masked to women's and children's treatment assignments. Variables were constructed without reference to this information.

Child outcomes were derived from tests of children's academic achievement and attention, interviews with children and parents, reviews of children's school records, and teachers' ratings of child behavior. Data for this report were derived primarily from the intake [6] and 12-year assessments, although data from previous assessments [7–9] also were used to create longitudinal data sets for examination of program impacts over time.

Primary outcomes were those that either were significant in other trials of the NFP at similar ages or had been significant at earlier phases of the current trial. Secondary outcomes are presented elsewhere.[15] The primary outcomes follow:

- Use of substances (cigarettes, alcohol, and marijuana) was assessed by interview for the 30-day interval preceding the 12-year interview: any substance use (yes/no); count of substances used (0–3); and count of days of substance use (theoretical range - 0–90).

- Reading and math achievement using the Peabody Individual Achievement Tests (PIAT).[16]

- Reading and math end-of-year grade point averages (GPA's) in grades 1–6; scores range 0–4.

- Reading and math achievement derived from Tennessee Comprehensive Assessment Program[17] (TCAP) test scores (percentiles) for grades 1–6.

- *Externalizing and Total Behavioral Problems.*[19] We scored parents', teachers', and youths' reports. Externalizing problems (e.g., aggression, breaking rules) and Total problems (externalizing, internalizing, and other maladaptive behaviors) were scored as positive whenever at least 2 of the 3 reporters gave the youth a score in the borderline or clinical range.

- *Internalizing Problems.* [19] We relied upon youth self-report in defining internalizing problems (e.g., anxiety, depression), as parents and teachers are less likely to observe accurately children's internal emotional states. We classified as positive those scores that crossed the borderline/clinical threshold.

- *Arrests*, reported by age 12 using maternal and child report.

Four outcomes reported here do not meet the definition of a primary outcome:

- *Special Education Placement in grades 1-6 (yes/no)*, abstracted from school records.

- *Grade Retention in grades 1-6 (yes/no)*, abstracted from school records.

- *Conduct grades* abstracted from children's school records, scored from 1 (unsatisfactory) to 4 (honors).

- Sustained Attention; using the Leiter-R Sustained Attention test.[18]

Statistical Models and Methods of Analysis

Analyses were conducted on all cases randomized insofar as outcome data were available. The core statistical model consisted of a 2-level treatment factor, a 2-level factor reflecting mothers' psychological resources (above versus below the sample median), a 2-level factor for child gender; all interactions among these three factors, and 2 covariates (household poverty and maternal childrearing attitudes associated with child maltreatment). Estimates and tests were adjusted for all covariates. We analyzed pared down models when data were sparsely distributed (noted in tables).

For quantitative outcomes on which we had multiple assessments for each child (e.g., grade point averages) we analyzed mixed models that included, in addition to the 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. For school performance outcomes (e.g., grade point averages), grade level was the repeated measure over time. When more than one subject area was analyzed jointly, the model included a second repeated-measures factor for area (i.e., math versus reading).

Continuous dependent variables were analyzed in the general linear model and dichotomous outcomes in the logistic-linear model. For low-frequency count outcomes (e.g. counts of substances children used), we analyzed the data in generalized linear models with negative binomial error assumptions.

The key tests focused on the treatment effect averaged over all other fixed classification variables, including those within subjects, and the same treatment effect restricted to the group defined by low psychological resources. The tables show the means over time, which also are averaged over other fixed classification effects. We report results averaged over the entire period for which we have data as well as the interval between 10 and 12 years (grades 4-6) of the first child's life, as the 10–12-year period reflects the time covered by this phase of follow-up. We show results for the entire time period for which we have data, as this allows a more complete examination of the full longitudinal effects of the program on outcomes.

We present outcomes as treatment main effects as well as effects for the group defined by mothers' having low psychological resources. The text includes estimates of Effect Sizes for continuous outcomes (mean differences divided by pooled standard deviations) to facilitate comparison of intervention impacts with different outcome measures and in different trials.

Results

Baseline Equivalence of Treatment Groups

The treatment groups were similar on background characteristics for those participants on whom 12-year follow-up assessments were conducted (Table 2), with the following exceptions: at intake, nurse-visited women, compared to controls, lived in households with less discretionary income, higher person-per-room density, and higher scores on the household poverty index; they also had higher scores on childrearing attitudes associated with child maltreatment.

Child Outcomes

In the 30-day period preceding the 12-year interview, as shown in Table 3, nurse-visited children, compared to controls, were less likely to have used either tobacco, alcohol, or marijuana (OR = 0.31, p=.036), to have used fewer of these substances (IR = 0.22, p =.016); and to have used these substances for fewer days (IR = 0.15, p = .019).

As shown in Table 4, nurse-visited children reported fewer internalizing disorders than did children in the control group (OR = 0.63, p =.043).

Table 5 shows that nurse-visited children born to low-resource mothers had higher PIAT achievement test scores in reading and math at age 12 (ES = 0.25, p =.009), higher grade-point averages and group-based achievement test scores in reading and math in grades 1-6 (ES = 0.18, p =.028; and ES = 0.22, p = .023, respectively), and higher grade point averages in reading and math in grades 4-6-grade (ES =0.18, p = 0.047).

There were no statistically significant program effects on children's sustained attention, externalizing or total behavioral problems, or conduct grades.

Discussion

The program effect on early starting substance use is important, in spite of the infrequency of its occurrence, because early starting substance use increases the risk for later health problems, including substance use disorders, risky sexual behavior, suicide, psychopathology, and violence.[21–23] The program effect on internalizing disorders is important because early onset internalizing disorders are risks for mood disorders [22] and use of addictive substances. [25, 26] Among urban black adolescents, symptoms of depression increase risk for violence. [27]

As in other studies, [28] internalizing disorders and substance use were strongly associated (p<.001). Sixty percent of the control-group children who reported using substances also reported having internalizing disorders in the borderline/clinical range; and among those with internalizing disorders, the rate of substance use was 5 times higher (11%) than among those without internalizing disorders (2%). These overlapping phenotypes (especially for children who use substances early in life) point to shared developmental risks and increased likelihood of later psychopathology and antisocial behavior. [29–31]

Since the earliest phases of follow-up in this trial, we have found that control-group children born to mothers with low psychological resources were compromised in a variety of ways, and that many of the impacts of the program on child outcomes were greater for children born to lower resource mothers. [6, 8, 9, 11] Consistent with earlier phases of follow-up, and with children's cognitive and language outcomes in a third trial of the NFP in Denver, CO, [32,33] nurse-visited children born to low-resource mothers in the Memphis trial had higher GPAs and group achievement test scores in reading and math in the first six years of school, and higher PIAT scores in reading and math at age 12 than did their control-group counterparts. The larger program effects observed for direct tests of children's achievement (ES = 0.25 in standard deviation units for the PIAT, ES=0.22 for the TCAP) than with GPA's (ES = 0.18) suggest that GPA's are less reliable measures of reading and math skills than standardized tests. Overall, these results suggest that nurses were able to improve low-resource parents' care of their children and help them reduce their children's exposures to damaging early experiences in this especially high-risk group. [11] The implications of these findings for children's long-term functioning have yet to be determined.

We conducted analyses to help us understand why treatment effects on special education and grade retention were not consistent with our hypotheses. Given that these outcomes are affected in part by parental awareness of their children's needs and advocacy for them, we wondered whether nurse-visited parents might have observed their children's developmental needs and advocated for them at lower thresholds of severity than their control-group counterparts. In support of this interpretation, nurse-visited children in special education and those who had been retained, as trends, had higher PIAT scores at age 12 than their counterparts in the control group (78.00 versus 73.10, ES=0.40, p=.055; and 83.78 versus 80.79, ES=0.29, p=.063, respectively). The point estimates of these differences, while relatively large, were imprecise because of small samples.

There were two unexpected subgroup effects for special education placement and grade retention. Among females born to high-resource mothers, those in the control group had lower rates of special education placement than their nurse-visited counterparts (3% versus 17%, p=.01) and among children born to high-resource mothers irrespective of gender, those in the control group had lower rates of retention than did those born to nurse-visited mothers (15% versus 28%, p=.04), data not shown. We examined baseline differences in background characteristics for these subgroups and found that the treatment-control difference in household poverty at registration during women's pregnancies favored the control group and was particularly pronounced. Our current judgment is that these differences are due to chance.

The positive findings from this phase of follow-up are encouraging, but must be interpreted in light of their limitations. One of these is that the program effect on achievement was present among children born to low-resource but not high-resource mothers. Given that academic achievement impacts were predicted to be more pronounced for children born to low-resource mothers, and that this pattern of program effects is consistent across trials and populations,[11, 32, 33] such concerns are mitigated. In addition, some of the effects of the program were based upon self-report (e.g., use of substances and internalizing disorders). The reports of these behaviors were associated in predictable ways with other behaviors, however, which supports their validity. Moreover, we examined several correlated outcomes within some domains, such as children's substance use and academic achievement. These measures are not separate outcomes so much as different aspects of the same finding. Finally, we examined a number of outcome domains and did not make statistical adjustments for multiple comparisons. Our primary criterion for determining the significance of any one finding, given the extraordinarily large samples required to examine multiple outcome domains in single trials, is replication across trials that sample different populations. [34, 35]

In general, the impacts of the program on children's emergent use of substances, internalizing disorders, and academic achievement among those born to low-resource mothers support the hypothesis that the program will continue to affect children's health and behavior, as found in an earlier trial.[5]

Acknowledgments

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Table 1

Sample Composition over Time by Treatment

Treatment Group Assignment	Control	Nurse-Visited
Number Allocated to Each Treatment	515	228
Miscarriages	19	8
Stillbirths	5	2
Infant and childhood deaths (0–12 years)	10	2
Maternal Deaths (though child age 12)	8	2
Refusals/drops (through age12)	17	10

Completed 12-yr Assessments - no. (%) of randomized *		
Maternal interviews	407 (79%)	187 (82%)
Other custody interviews (no maternal)	15 (3%)	4 (2%)
Maternal or Other custody	422 (82%)	191 (84%)
Child interview	398 (77%)	180 (79%)
Teacher reports (firstborn child)	378 (73%)	170 (75%)
School records (firstborn child)	439 (85%)	196 (86%)
Social service records[a]	422 (82%)	191 (84%)

[a]Data used in accompanying article[10]

Table 2

Background Characteristics of Those Participants on Whom 12-Year Assessments Were Completed

		Treatment Group	
		Control N = 422[a]	Nurse Visited N = 191[a]
Background Variable	**Sample**	**%**	**%**
Married	Whole	1.4	1.1
	Low-Resource	0.9	1.9
Maternal Race, Non-Black	Whole	5.7	8.4
	Low-Resource	5.0	8.7
Head of Household Employed	Whole	55.6	49.5
	Low-Resource	52.5	48.5
Drank Alcohol Last 14 Days	Whole	4.0	4.7
	Low-Resource	5.4	6.7
Smoked Cigarettes Last 3 Days	Whole	8.1	10.5
	Low-Resource	8.1	12.5
Used Marijuana Last 14 Days	Whole	1.7	1.1
	Low-Resource	1.8	1.9
Any Drug Use (screen)	Whole	4.4	4.4
	Low-Resource	7.8	6.1
Any Sexually Transmitted Disease, Pre-randomization	Whole	34.7	37.2
	Low-Resource	34.8	39.4

		Mean	**(SD)**	**Mean**	**(SD)**
Maternal Age	Whole	18.05	(3.21)	18.05	(3.27)
	Low-Resource	18.14	(3.34)	18.13	(3.82)
Gestational Age at Randomization, Weeks	Whole	16.47	(5.83)	16.61	(5.64)
	Low-Resource	16.37	(5.91)	16.90	(5.62)
Psychological Resources Index[b,c]	Whole	99.86	(9.65)	99.66	(10.91)
	Low-Resource	92.46	(5.64)	91.73	(6.77)
Highest Grade Completed – Mother	Whole	10.25	(1.86)	10.07	(2.02)
	Low-Resource	9.95	(1.94)	9.52	(2.04)
Discretionary Household Income[d]	Whole	1595	(6812)	−16	(6543)
	Low-Resource	18	(6424)	−1202	(6173)
% of Census Tract Below Poverty	Whole	34.80	(21.38)	35.73	(20.18)
	Low-Resource	36.00	(21.29)	34.99	(21.25)

		Mean	**(SD)**	**Mean**	**(SD)**
Housing Density[e]	Whole	0.94	(0.48)	1.02	(0.56)
	Low-Resource	1.02	(0.53)	1.11	(0.50)
Conflict with Mother[c,a,f]	Whole	100.01	(10.60)	100.67	(9.20)
	Low-Resource	101.80	(12.86)	101.34	(10.04)
Conflict with Partner[c,f]	Whole	99.62	(10.20)	100.43	(9.47)
	Low-Resource	100.06	(11.67)	101.95	(10.96)
Attitudes toward Childrearing Predictive of Child Abuse[c]	Whole	99.92	(9.55)	101.35	(10.77)
	Low-Resource	102.82	(8.94)	104.65	(9.72)
Household Poverty Index[c,g]	Whole	99.62	(9.85)	101.93	(9.95)
	Low-Resource	101.66	(10.02)	103.74	(9.59)
Age of study child at interview	Whole	12.95	(0.42)	12.98	(0.51)
	Low-Resource	12.93	(0.39)	12.99	(0.57)
Neighborhood Disadvantage Index[a]	Whole	2.34	(1.59)	2.41	(1.81)
	Low-Resource	2.51	(1.53)	2.26	(1.70)

[a]Low-resource group: control n=222; nurse-visited n=104

[b]Average z-scores of women's sense of mastery/self-efficacy, mental health, and intellectual functioning.

[c]Standardized to sample mean = 100, SD = 10

[d]Household income derived from administrative records used to determine eligibility for indigent prenatal care.[6]

[e]Persons per room

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

[g]Average z-scores of household discretionary income, housing density, and whether head of household was employed.

[h]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).[20]

Table 3

Adjusted Estimates of Program Effects on Children's Emergent Use of Substances

		Treatment Group		Treatment Contrast[a]	
		Control	Nurse-Visited	Control vs. Nurse	
Dichotomous Outcomes	**Sample**	**%**	**%**	**P-value**	**Odds Ratio (CI)**
Used cigarettes, alcohol, or marijuana – last 30 days[b]	Whole	5.1	1.7	0.036	0.31 (0.09, 1.07)

Low-Frequency Count Outcomes		**Incidence**	**Incidence**	**P-value**	**Incidence Ratio (CI)**
No. of substances used – last 30 days[b]	Whole	0.08	0.02	0.016	0.22 (0.06, 0.83)
No. days used substances – last 30 days[b]	Whole	0.18	0.03	0.019	0.15 (0.04, 0.65)

[a]Confidence intervals are estimated from Wald tests, whereas the p-values are based upon Likelihood Ratio tests.

[b]Analyses based upon a model that included Treatments only.

Table 4

Adjusted Estimates of Program Effects on Children's Behavior and Mental Health

| | | Treatment Group | | Treatment Comparison | |
| | | Control | Nurse-Visited | Control vs. Nurse | |
Dichotomous Outcomes	**Sample**	**%**	**%**	**p-value**	**Odds Ratio (CI)**
Ever Arrested[a]	Whole	3.1	3.1	0.974	0.99 (0.41, 2.38)
Internalizing disorders – self report	Whole	30.9	22.1	0.043	0.63 (0.40, 1.00)
	Low-Resource	36.2	31.5	0.425	0.81 (0.48, 1.36)
Externalizing disorders (teacher-, parent-, self-report)	Whole	17.8	19.7	0.604	1.13 (0.71, 1.81)
	Low-Resource	21.6	23.6	0.710	1.12 (0.62, 2.01)
Total Problems (teacher-, parent-, self-report)	Whole	19.8	23.7	0.312	1.26 (0.81, 1.97)
	Low-Resource	26.5	29.6	0.571	1.17 (0.68, 2.00)

Continuous Outcomes		**Mean**	**(SE)**	**Mean**	**(SE)**	**p-value**	**Mean Difference**
Conduct Grades – Grades 1–6[b]	Whole	2.89	0.03	2.95	0.04	0.205	0.06 (−0.03, 0.16)
	Low-Resource	2.86	0.04	2.93	0.05	0.287	0.07 (−0.06, 0.20)
Conduct Grades – Grades 4–6[b]	Whole	2.88	0.03	2.95	0.05	0.217	0.07 (−0.04, 0.19)
	Low-Resource	2.86	0.05	2.91	0.06	0.489	0.05 (−0.10, 0.21)

[a]Analyses based upon a model that included Treatments only.

[b]Outcome examined with repeated measures.

Table 5

Adjusted Estimates of Program Effects on Children's Academic Performance

		Treatment Group			Treatment Contrast
		Control	Nurse-Visited		Control vs. Nurse
Dichotomous Outcomes	**Sample**	**%**	**%**	**p-value**	**Odds Ratio (CI)**
Ever Placed in Special Education – Grades 1–6	Whole	9.8	14.8	0.108	1.61 (0.89, 2.90)
	Low-resource	15.1	14.7	0.925	0.97 (0.51, 1.85)
Ever retained	Whole	20.8	24.9	0.302	1.26 (0.81, 1.97)
	Low-resource	27.3	22.5	0.352	0.77 (0.44, 1.34)

Continuous Outcomes		**Mean**	**(SE)**	**Mean**	**(SE)**	**p-value**	**Mean Difference**
PIAT Achievement Test Scores (reading and math) – 12 years[a]	Whole	87.96	0.49	89.24	0.72	0.145	1.27 (−0.44, 2.98)
	Low-Resource	85.70	0.67	88.78	0.99	0.009	3.07 (0.76, 5.39)
GPA (Reading and Math) – Grades 1–6[a]	Whole	2.39	0.04	2.48	0.05	0.188	0.09 (−0.04, 0.22)
	Low-Resource	2.27	0.05	2.46	0.07	0.028	0.20 (0.02, 0.37)
GPA (Reading and Math) – Grades 4–6[a]	Whole	2.20	0.04	2.28	0.06	0.237	0.08 (−0.06, 0.23)
	Low-Resource	2.08	0.06	2.27	0.08	0.047	0.19 (0.00, 0.38)
Group Achievement Tests Scores (Reading and Math) – Grades 1–6[a]	Whole	39.79	1.03	42.34	1.52	0.166	2.55 (−1.05, 6.15)
	Low-Resource	34.85	1.44	40.52	2.07	0.023	5.67 (0.80, 10.55)
Group Achievement Tests Scores (Reading and Math) – Grades 4–6[a]	Whole	38.27	1.05	39.37	1.56	0.563	1.09 (−2.61, 4.80)
	Low-Resource	33.67	1.46	36.86	2.14	0.213	3.19 (−1.83, 8.21)
Leiter Sustained Attention scaled score	Whole	8.75	0.14	8.68	0.21	0.789	−0.07 (−0.58, 0.44)
	Low-Resource	8.72	0.20	8.63	0.29	0.793	−0.09 (−0.77, 0.59)

[a]Outcome examined with repeated measures.