BRIEF REPORT

Developmental Outcome of Drug-Exposed Children Through 30 Months: A Comparison of Bayley and Bayley–II

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This study examined the effects of the Bayley Scales of Infant Development (BSID) version on developmental outcomes among drug-exposed children, some of whom received an intervention. Developmental outcome was evaluated with the BSID at 12 and 18 months and with the BSID–II at 24 and 30 months. In the repeated measures analyses, children scored higher on the BSID Mental Developmental Index (MDI; $p < .01$) and Psychomotor Developmental Index (PDI; $p < .01$) than on the BSID–II MDI and PDI. Version × Time ($p < .01$) and Version × Group ($p < .01$) interactions were also found for the MDI but not the PDI. PDI scores decreased on both the BSID and the BSID–II ($p < .01$). Over the first 2 years postpartum, mean MDI and PDI scores decreased among these high-risk, drug-exposed children.

The Bayley Scales of Infant Development (BSID; Bayley, 1969) was a well-established measure that assessed the mental, motor, and behavioral development of infants. However, over the 2 decades it was used, scores on the BSID drifted upward (Campbell, Siegel, Parr, & Ramey, 1986). Thus, one of the reasons for developing the Bayley Scales of Infant Development—II (BSID–II; Bayley, 1993) was to revise the BSID norms (Black & Matula, 2000).

Prenatal drug exposure has sometimes been associated with poor developmental outcomes (Arendt, Singer, Angelopoulos, Bass-Busdiecker, & Mascia, 1998; Singer et al., 1997). However, home-based (Black et al., 1994) and combined home- and center-based interventions (Kilbride, Castor, Hoffman, & Fuger, 2000) are associated with higher cognitive outcomes among drug-exposed infants in early infancy.

Regardless of prenatal drug exposure, children living in poverty are at risk for cognitive delays (Brooks-Gunn, Klebanov, & Duncan, 1996; Petterson & Albers, 2001). Children from low-income families score within the normal range on cognitive assessments in early infancy but then experience declines as toddlers and preschoolers (Hurt et al., 1995, 1997).

The purpose of the present study was to compare the scores on the BSID and the BSID–II among a group of drug-exposed children, some of whom received an intervention. Because one of the reasons for revising the original BSID was to update the norms, we hypothesized that the children's scores on the BSID–II would be lower than their scores on the BSID.

Method

Participants

The recruitment methods have been described previously (Schuler, Nair, & Black, 2002; Schuler, Nair, Black, & Kettinger, 2000; Schuler, Nair, & Kettinger, 2003). The present study included 118 families (57 control, 61 intervention). Originally, 258 mothers and their infants were enrolled in the study. The reasons for participant loss in the present study are presented in Table 1. There were no significant group differences on any variable between those dyads included and those dyads not included in the present study.

Procedure

Mothers who agreed to participate signed a consent form approved by the Institutional Review Board of the University of Maryland and completed a demographic and tracking form shortly after giving birth. At the end of a 2-week baseline visit, the mothers and their children were randomly assigned to an intervention group or a control group. Mothers and their children were seen for clinic evaluation visits at 6, 12, 18, 24, and 30 months postpartum. Research assistants who were unaware of the intervention status of the mothers and children conducted all evaluation visits in a hospital clinic. All mothers were given information on drug treatment programs; however, treatment was not mandatory for participation in the study. Mothers were paid for each clinic evaluation visit and given bus tokens to get home. Only data relevant to the present study are reported here.

When recruitment in the present study began in 1992, the BSID was the only version available. By the time the BSID–II was available in 1993, the BSID had already been administered to some of the children at 6, 12, and 18 months postpartum. To keep the Bayley version consistent within

Table 1
Reasons for Participant Loss in the Present Study

Reason for loss	No. of participants ($N = 140$)
Infant died	6
Foster care parent refused to continue in study	40
Family could not be found	12
Mom withdrew	3
Error in recruitment	3
Family noncompliant with at least 1 scheduled evaluation visit	70
Family moved out of state	4
Mom entered long-term residential drug treatment	1
Child had uncorrected vision problems	1

child visits, the BSID was administered to all of the children at the 6-, 12-, and 18-month clinic visits. The BSID–II was administered to all of the children at the 24- and 30-month clinic visits.

Home Visiting

Mothers in the intervention group received weekly home visits during the first 6 months postpartum and biweekly home visits from 6 to 24 months postpartum. The mean number of home visits made during the 24 months was 22.0 ($SD = 12.2$, range = 2–53), and the mean length was 28.9 min ($SD = 4.1$). Mothers in the control group received brief monthly home tracking visits to reduce attrition. The mean number of home visits made during the 24 months was 9.9 ($SD = 4.2$, range = 0–22), and the mean length was 17.6 min ($SD = 6.2$).

The home intervention protocol has been described previously (Schuler et al., 2000, 2002, 2003) but is summarized here for clarity. The home intervention was based on the program used by the Infant Health and Development Program (1990) and had both a parent and a child component. The goal of the parent component was to increase maternal empowerment by enhancing the mothers' ability to manage self-identified problems. The goal of the child component was to promote child development through the use of the *HELP at Home: Hawaii Early Learning Profile* (1991).

Measures

Development. The BSID is a well-established measure of the mental, motor, and behavioral development of infants. On the BSID, raw scores were converted to standardized scores ($M = 100$, $SD = 16$), yielding a Mental Developmental Index (MDI) and a Psychomotor Developmental Index (PDI). The BSID–II still yields an MDI and a PDI with a mean of 100; however, the standard deviation was changed to 15 to make it similar to most other cognitive assessments. In the present study, MDI and PDI scores on the BSID and the BSID–II were age-corrected for premature infants (Bayley, 1969, 1993). Because the revised behavior scales on the BSID–II are so different from the behavior scales on the BSID, we did not attempt to compare behavior scores across Bayley versions.

Maternal drug use. All of the mothers in the present study had a history of prenatal cocaine and/or heroin use. As part of the 2-week baseline evaluation, a drug form was administered to the mothers.

Results

Statistical analyses were performed using SPSS for Windows. We used *t* tests and chi-square analyses to determine whether there were any differences between the control and intervention mothers or children. There were no significant group differences on any maternal or infant variable (see Table 2).

During the first 30 months postpartum, a number of children ($n = 39$) were placed with alternate caretakers. Children with alternate caretakers may have different developmental outcomes than those who remain with their biological mothers; therefore, we ran two repeated measures analyses using change in custody as an independent variable. Change in custody was not significant in any analysis as an independent variable, and all other findings were the same whether change in custody was included in the analyses or not; therefore, we report the simpler analyses without change in custody.

Two repeated measures analyses were performed with developmental scores at 12, 18, 24, and 30 months as the dependent variables. We performed separate analyses for the MDI and PDI scores. In both analyses, there was one between-subjects factor—group (control vs. intervention)—and two within-subjects factors—BSID version (original vs. revised) and administration time (first and second, which corresponded to 12 and 18 months respectively for the BSID, and third and fourth, which corresponded to 24 and 30 months respectively for the BSID–II). These analyses simultaneously tested several main effects (group, version, and time) and interactions (Group × Version, Group × Time, Version × Time, and Group × Version × Time) for mental and motor development.

In the first repeated measures analysis, the dependent variables were the MDI scores at 12, 18, 24, and 30 months. Table 3 provides the means and standard deviations for the MDI scores. Significant effects of time, $F(1, 116) = 37.81$, $p < .01$; version, $F(1, 116) = 594.78$, $p < .01$; Version × Group, $F(1, 116) = 5.37$, $p < .05$; and Version × Time, $F(1, 116) = 46.50$, $p < .01$, were found; all other main effects and interactions were nonsignificant ($p > .05$).

The Version × Time interaction indicated that there was more of a drop in scores over the 6 months between the first and second administrations of the BSID ($M = 103.20$, $SE = 1.10$ at 12 months; $M = 94.15$, $SE = 1.17$ at 18 months) than for the BSID–II ($M = 78.93$, $SE = 1.14$ at 24 months; $M = 79.63$, $SE = 0.81$ at 30 months). The Version × Group interaction indicated a slightly smaller drop from BSID to BSID–II for the control group ($M = 96.74$, $SE = 1.41$ for the BSID; $M = 79.18$, $SE = 1.31$ for the BSID–II) than for the intervention group ($M = 100.62$, $SE = 1.36$ for the BSID; $M = 79.38$, $SE = 1.26$ for the BSID–II). The version effect indicated that scores were higher on the BSID ($M = 98.68$, $SE = 0.98$) than on the BSID–II ($M = 79.28$, $SE = 0.91$).

In the second repeated measures analysis, the dependent variables were the PDI scores at 12, 18, 24, and 30 months. Table 3 provides the means and standard deviations for the PDI scores. Significant effects of time, $F(1, 116) = 16.70$, $p < .01$, and version, $F(1, 116) = 235.55$, $p < .01$, were found; all other main effects and interactions were nonsignificant ($p > .05$).

The time effect indicated that scores were slightly higher on the first administration ($M = 97.21$, $SE = 1.07$) than on the second administration ($M = 94.08$, $SE = 0.77$). The version effect indicated that scores were higher on the BSID ($M = 102.31$, $SE = 0.97$) than on the BSID–II ($M = 88.98$, $SE = 0.94$).

Table 2

Maternal Demographic and Infant Perinatal Characteristics Among Control and Intervention Groups

Characteristic	Control (*n* = 57) M	SD	Intervention (*n* = 61) M	SD
Maternal characteristic				
Age at entry (years)	27.3	5.2	26.8	5.5
Education (years)	11.0	1.8	10.8	1.5
Single (%)	96		90	
Unemployed (%)	98		100	
African American (%)	96		93	
Use during the pregnancy (%)				
Cigarettes	86		78	
Alcohol	56		59	
Marijuana	44		31	
Cocaine	71		69	
Heroin	56		57	
Methadone	27		19	
Tranquilizers	2		5	
Amphetamines	0		2	
Barbiturates	0		0	
Hallucinogens	0		0	
Infant characteristic				
Birth weight (g)	2,813	501	2,751	417
Head circumference (cm)	32.6	1.7	33.0	2.6
Birth length (cm)	48.3	3.0	47.8	3.0
Gestational age (weeks)	38.9	2.3	38.4	2.2
1-min Apgar score	8.0	1.0	8.1	1.1
5-min Apgar score	8.9	0.3	8.9	0.5
Male (%)	47		48	

Discussion

There was a significant version effect, with higher scores on the BSID than the BSID–II for both the MDI and the PDI. Unfortunately, in this study version was confounded with age in that the children were younger when given the BSID (12 and 18 months of age) than when given the BSID–II (24 and 30 months of age). Hurt et al. (1995, 1997) found that children living in poverty had normal development during early infancy, with declines as toddlers and preschoolers. Although it is possible that the version effect is due to the developmental effects that others have found (Hurt et al.,

1995, 1997), three factors suggest that the findings are at least in part due to the different Bayley versions. First, the largest observed drops were from 18 to 24 months for both the MDI and the PDI; much smaller drops were found within Bayley versions (e.g., from 12 to 18 months and from 24 to 30 months). Second, the MDI scores were almost identical at 24 and 30 months, suggesting that development was not continuing to decline. Third, the drops observed from 18 to 24 months were very similar to the drops observed in the standardization sample (Bayley, 1993)—there was a 12-point drop in MDI scores and a 7-point drop in PDI scores

Table 3

A Comparison of BSID and BSID–II Scores Among Control and Intervention Children

Index and group	BSID 12 months M	SD	BSID 18 months M	SD	BSID–II 24 months M	SD	BSID–II 30 months M	SD
MDI								
Control[a]	100.7	11.2	92.7	12.8	78.7	12.3	79.6	9.4
Intervention[b]	105.7	12.5	95.6	12.6	79.1	12.5	79.6	8.2
PDI								
Control[a]	101.9	15.9	99.8	11.1	90.8	13.5	85.6	11.5
Intervention[b]	104.5	13.8	103.1	8.3	91.6	12.0	87.9	9.9

Note. BSID = Bayley Scales of Infant Development; BSID–II = 2nd ed. of BSID; MDI = Mental Developmental Index; PDI = Psychomotor Developmental Index.
[a] *n* = 57.　[b] *n* = 61.

from the BSID to the BSID–II compared with a 14-point drop in MDI scores among control children and an 11-point drop in PDI scores among intervention children in the current sample.

BSID–II validity data were collected on normal and drug-exposed children (Bayley, 1993). The scores in the present study were much lower than the scores among drug-exposed children in the standardization sample (MDI = 90.8, PDI = 96.3). However, the standardization sample was mostly White and ranged in age from 1 to 40 months. Similar to the population in the present study, the standardization sample of drug-exposed children had lower scores on the MDI when compared with the PDI and had low average to average scores.

The data in the present study must be interpreted with caution. First, participants in the present study were volunteers; therefore, this group may not be representative of all drug-using mothers. Second, only those families in which the infant was discharged at birth into the mother's care were included. Even though they admitted to drug use, these mothers may have been doing better in some way so that it was believed that they were capable of caring for their children. Finally, although perinatal urine screens were obtained on most of the infants, prenatal drug use was based on maternal self-report.

Similar to previous research (Hurt et al., 1995, 1997) drug-exposed children in the present study experienced a decrease in BSID scores over time. However, the BSID scores appeared to stabilize between 24 and 30 months postpartum. In the present study, BSID version (BSID vs. BSID–II) was confounded with the age of the child; therefore, it was not possible to determine whether the decrease in BSID scores was due to time or BSID version, although previous research has indicated that children living in poverty are at risk for poor developmental outcomes (Brooks-Gunn et al., 1996; Petterson & Albers, 2001).

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