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The effect of socioeconomic status on the language outcome of preterm infants at toddler age

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ABSTRACT

Background: Independently, both prematurity and low socioeconomic status (SES) compromise language outcome but less is known regarding the effects of low SES on outcome of prior preterm infants at toddler age.
Aim: To assess SES effects on the language outcome of prior preterm infants at toddler age.
Study design: Retrospective chart review of infants born at ≤32 weeks, matched for gestational age (GA), birth weight (BW), chronic lung disease (CLD), periventricular leukomalacia (PVL), right and left intraventricular hemorrhage (IVH-R, L), and age at Bayley Scales of Infant Development III (BSID-III) testing.
Subjects: Using insurance status as a proxy for SES, 65 children with private insurance (P-Ins) were matched with 65 children with Medicaid-type insurance (M-Ins).
Outcome measures: Bayley Scales of Infant Development-III Language Composite.
Results: M-Ins vs. P-Ins were similar in GA, BW, and age at BSID-III testing (mean 22.6 months adjusted), as well as other matched characteristics (all $p \geq 0.16$). BSID-III Language Composite scores were lower in M-Ins than P-Ins (87.9 ± 11.3 vs. 101.9 ± 13.6) with a clinically significant effect size of 0.93 ($p < 0.001$). Overall, 45% of M-Ins exhibited mild to moderate language delay compared to 8% of P-Ins. Receptive and Expressive subscale scores also were lower in M-Ins than in P-Ins (both $p < 0.001$).
Conclusions: In this preterm cohort, by toddler age, M-Ins was associated with lower scores on measures of overall language as well as receptive and expressive language skills. Our findings, showing such an early influence of SES on language outcome in a cohort matched for biomedical risk, suggest that very early language interventions may be especially important for low SES preterm toddlers.

1. Introduction

Prematurity is associated with risk for poor developmental outcome, including difficulties in language development [1–7]. Low socioeconomic status (SES) also is associated with poor developmental outcomes [8,9]. Less is known regarding the influence of SES on the language development of prior preterm infants, however, several studies suggest that there is a negative effect. Socioeconomic variables such as income, maternal age and education, ethnicity, and residence in a 2-parent household have been found to influence the language outcomes of low-birth-weight children [1,4,5,10]. In a recent study, Foster-Cohen et al. demonstrated that SES variables explained a notable portion of the variance in receptive and expressive language scores between preterm (≤33 weeks gestational age [GA]) and full-term children at age four years [5]. Comparing preterm children of both high and low medical risk with term children, Landry et al. found that not only prematurity and medical risk status predicted language outcome, but also low SES had comparable negative effects on the rate of language development in all three groups by age eight years [4]. No data were given for SES effects on language outcomes of children younger than age four years in either study.

Children in low SES environments are exposed less often to experiences that promote language development, such as conversation, reading, and other opportunities for learning in the home [11]. Low SES children also are at higher risk for prematurity [12], thus the documented associations between preterm birth and later language outcomes may be at least partially a result of the often disadvantaged environment found in low SES settings. Taken together, low SES preterm children may experience a "double jeopardy" of risk for language difficulties as a result of their prematurity in combination with a less stimulating environment [3–5]. While the above mentioned studies report an SES effect on language outcome, none were conducted with the sole objective of assessing SES effects in preterms of matched biomedical risk at a very young age. Early identification of language difficulties is particularly important for children experiencing this "double jeopardy". The objective of this investigation was to

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assess, at toddler age, the influence of SES on the language development of prior preterm infants matched for biomedical risk. Here, language was assessed using the BSID-III and insurance status was used as a proxy for SES.

2. Methods

This was a retrospective chart review of data collected at the Special Babies Clinic (SBC), a follow-up clinic for high-risk infants hospitalized in the intensive care nursery at the Hospital of the University of Pennsylvania. Participants were eligible if they were: 1) assessed with the BSID-III a minimum of once between ages 15 and 30 months; and 2) born at ≤32 weeks GA. Between 2006 and 2010, 2782 visits were completed in SBC on children ranging from 6 weeks post discharge from the hospital through age 60 months. Of these visits, 2307 (83%) were not considered for study inclusion for the following reasons: 1) testing was completed with the BSID-III but at ages younger than 15 months or older than 30 months; or 2) infants were born at greater than 32 weeks gestational age. The remaining 475 (17%) SBC visits were completed for 358 children who were considered eligible for the study. Insurance status, a proxy for SES [13–15], was used to dichotomize eligible children into either a Medicaid-type insurance (M-Ins) group or a private insurance (P-Ins) group. Children who failed hearing screens, required laser therapy for retinopathy of prematurity (ROP), or were from non-English speaking families were excluded. Ages were adjusted for prematurity until children reached 24 months of chronological age, as per BSID-III guidelines [16].

For enrollment, children with M-Ins were manually matched by one of the authors (KTW) to children with P-Ins with the following ordered matching strategy: gestational age, age at BSID-III testing, birth weight, then biomedical risk factors (right and left intraventricular hemorrhage [IVH-R,L], periventricular leukomalacia [PVL], and chronic lung disease [CLD]). For children born of multiple gestation, the child who matched most closely was included and the other was eliminated from the pool of eligible children. Because of the quality improvement nature of the data collected, the Institutional Review Board (IRB) at The Children's Hospital of Philadelphia did not require an approved IRB consent form.

2.1. BSID-III

Language development was evaluated with the BSID-III, which provides separate cognitive, language, and motor assessments of development [16]. This designation of language as a separate domain is a major distinction of the BSID-III from the older BSID-II which combined cognitive and language performance into one composite, the Mental Development Index (MDI). Each of these three dimensions, cognitive, language, and motor, has a standard score of 100 ± 15 (mean ± 1 SD). Scores < 70 (>2 SD below the mean) are considered "extremely low" and indicate severe delay, while scores between 70 and 84 (>1 SD below the mean) are considered "low average" and indicate mild to moderate delay. The BSID-III standardization sample of 1700 children is representative of the 2000 US Census population survey data for parent education, ethnicity, and geographic location [16]. The Language Composite Score consists of 2 subscales, Expressive Language and Receptive Language, both of which have mean scores of 10 ± 3. The Expressive Language subscale measures the ability of the child to communicate, through words and gestures, while the Receptive Language subscale tests the child's ability to comprehend and to respond appropriately to words and requests. Average reliability coefficients are all >0.94 in preterm infants [16].

2.2. Statistical analysis

Primary outcome variables included BSID-III Language Composite, and Expressive Language and Receptive Language subscale scores. Bivariate comparisons of the matched insurance groups were performed using paired t-tests for continuous outcome variables, and McNemar and Wilcoxon signed-rank tests for ordinal or categorical outcome variables. Pearson correlations were used in secondary analyses to examine the relationship between GA and language scores.

3. Results

Matching for the criteria described above, 65 pairs of children (65 M-Ins and 65 P-Ins) were identified from the 358 eligible children. Child and maternal characteristics are presented in Table 1. A higher percentage of the children in the M-Ins group were African American. Mothers of children in the M-Ins group were younger, more likely to have used drugs during pregnancy, and more likely to have had no prenatal care, which is consistent with participant descriptions in other studies with low SES populations. The matching variables listed in the table show the two insurance groups to be similar, as expected, with respect to sex, GA, BW, age at BSID-III testing (mean difference in age was 0.57 ± 2.7 months), and incidence of CLD, PVL, and IVH-RL (all p ≥ 0.16). Despite similar neonatal morbidities, groups differed markedly in language scores (Table 2): BSID-III Language Composite scores averaged 14 points lower in the M-Ins than in the P-Ins group with a clinically significant effect size of 0.93 (p < 0.001). Receptive and Expressive subscale scores also were lower in the M-Ins than in the P-Ins group (both p < 0.001). The effect sizes for the group differences in Receptive and Expressive subscale scores also represent clinically significant effects of insurance status on these specific components of language, 0.60 and 1.00, respectively. To determine if using scores adjusted for prematurity affected results, we repeated the analyses using only chronologic scores for all children. For both M-Ins and P-Ins groups, mean unadjusted scores were slightly lower; however, differences between M-Ins and P-Ins remained large with an effect size of 0.80 (p < 0.001).

Using the BSID-III functional groupings, 45% of the M-Ins group was mildly to moderately delayed compared to only 8% of the P-Ins group (36% M-Ins mildly delayed vs. 8% P-Ins; 9% M-Ins moderately delayed vs. 0% of the P-Ins group (p < 0.001)) (Table 2). BSID-III Cognitive and Motor Composite scores also differed between the M-Ins and the P-Ins groups (p ≤ 0.043).

Because preterm infants as a group are at greater risk for poor language development than term infants [6,10], in a secondary analysis, we examined the relationship between GA and language scores in our

Table 1
Characteristics of matched cohort.

	M-Ins (n = 65)	P-Ins (n = 65)	p-value
Birth characteristics			
Maternal age at time of delivery	26.3 ± 6.6	31.5 ± 4.9	<0.001
Gestational substance use	6 (9.5%)	1(1.6%)	0.062
No prenatal care	6(9.5%)	0	0.013
Race, African American	56(86.2%)	24(36.9%)	<0.001
Matched characteristics			
Sex, female	34 (52.3%)[a]	36 (55.4%)	0.73[b]
GA, wks	29.3 ± 3.5[c] (24–32)[d]	29.3 ± 3.7 (24–32)	0.32[b]
BW, kg	1.33 ± 0.44 (0.52–2.82)	1.34 ± 0.43 (0.59–2.58)	0.65[b]
Age at BSID-III testing, mos.	22.9 ± 3.7 (18–29)	22.4 ± 3.5 (15–29)	0.16[b]
CLD	10 (15.4%)	10 (15.4%)	0.32[e]
PVL	1 (1.5%)	0 (0%)	0.32[e]
IVH (right)[f]	12 (18.4%)	14 (21.5%)	0.78[e]
IVH (left)[f]	8 (12.3%)	11 (17.0%)	0.45[e]

[a] N (%).
[b] t-test.
[c] Mean ± SD.
[d] Range.
[e] McNemar.
[f] All IVH grades I–II only.