Cumulative Risk and Low-Income Children's Language Development

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This study utilized an electronic data linkage method to examine the effects of risk factors present at birth on language development in preschool. The *Preschool Language Scale-3* (PLS-3) was administered to 853 low-income children, and cumulative risk data were abstracted from linked birth records. At least one risk factor was present in 94% of this sample, while 39% were exposed to three or more risk factors. On average, a girl's PLS-3 Total Score decreased by 2.3 points with each risk factor; the average decrease for boys was 1.1 point per risk factor. The accumulation of multiple risk factors thus appears to increase the negative effects of poverty. Researchers are encouraged to use historical administrative data sets to support prevention and early identification efforts.

Risk has been broadly defined as exposure to the biological and environmental conditions that increase the likelihood of negative developmental outcomes (Brooks-Gunn, 1990). Identifying factors related to developmental disabilities has been a major focus of risk research. Traditionally, a strong emphasis has been placed on early risk factors because the individual is believed to be particularly vulnerable to biological and environmental conditions in the early phases of the developmental process. Biological risk factors center on the characteristics of the individual that negatively affect development, such as prematurity, low birthweight, and perinatal complications (Adams, Hillman, & Gaydos, 1994). Environmental risk factors include low socioeconomic status, adverse neighborhoods, and parental psychopathology (Laucht et al., 2000).

Poverty places children at increased risk for a host of problems, beginning at conception (Halpern, 2000). Poverty significantly heightens the risk of exposure to physical health problems such as asthma, malnutrition, and elevated blood levels (Klerman, 1991); mental health problems (Gore & Eckenrode, 1996; McLoyd, 1990; McLoyd & Wilson, 1991); inattentive or erratic parental care (Halpern, 1993); removal from the home and placement in foster care due to abuse and neglect (Halpern, 2000); and deficits in cognitive development and achievement (Duncan, Klebanov, & Brooks-Gunn, 1994; Levin, 1991). Some researchers have suggested that poor families are exposed to more risk factors than families not below poverty level and that the consequences of these risk factors can be more severe for the children in these families (Attar, Guerra, & Tolan, 1994; Brooks-Gunn, Klebanov, & Liaw, 1995; Liaw & Brooks-Gunn, 1994; McLoyd, 1990).

Children exposed to multiple risk factors are at an increased risk for developing a disability. One such disability is *specific language impairment* (SLI), which is generally defined as poor achievement in language despite having normal hearing and nonverbal intelligence (Spitz, Tallal, Flax, & Benasich, 1997). More specifically, it is a condition that causes a child to score a specified degree below average on standardized tests of language performance but at an average level on tests of nonverbal intelligence (Fazio, Naremore, & Connell, 1996). To be at risk for SLI means that "individuals with certain characteristics are more likely to have an undiagnosed language impairment or will develop this condition in the future than children without these characteristics" (Finkelstein & Ramey, 1980, p. 546). Thus, SLI prevention means identifying at-risk children before a diagnosis is formally made. Early identification of these children is important to ensure that they will be placed in the appropriate remedial programs designed to minimize or eliminate the effects of these risks.

Researchers have conducted a number of studies examining the biological risk factors for SLI and other pro-

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gram placements by looking at the school outcomes of children who were placed in neonatal intensive care units (NICUs) immediately postpartum. Children from this population are known to be at risk for later cognitive and academic difficulties because they usually are born prematurely, have a low birthweight (less than 2,500 g) or have respiratory distress. The bulk of the literature has indicated that although children from NICU environments are at risk for more cognitive difficulties (such as mental retardation and learning disabilities), they are not at an increased risk for specific language problems, especially when their scores are adjusted because of prematurity (Resnick et al., 1998; Rice, Spitz, & O'Brien, 1999; Siegel et al., 1982; Tomblin, Smith, & Zhang, 1997).

Several studies have demonstrated that language impairments generally run in families, with reported aggregation rates of between 40% and 70% (Beitchman, Hood, & Inglis, 1990; Spitz et al., 1997; Tallal, Ross, & Curtiss, 1989; Tomblin, Smith, & Zhang, 1997). This means that approximately half of the families of children with language impairments have at least one other family member who has a language problem. Thus, parental influences on offspring may be attributed to genetic factors. What is not known is how much of the intergenerational transmission of language difficulties is caused by a lack of environmental support for language.

The environmental context in which a child is raised has long been recognized as crucial in determining developmental outcomes. Many children come from homes in which instability and a lack of continuity of care, accompanied by inadequate nutrition and medical care, may constitute a level of environmental stress that is detrimental to their functioning in a number of areas, including language (Wells, 1980). For this reason, the risk of language problems has been associated with socioeconomic factors and economic deprivation. Researchers have discussed several environmental variables that seem more predictive than others of future language disorder:

1. higher birth order (Hoff-Ginsberg, 1998; Neils & Aram, 1986; Pine, 1995; Tallal et al., 1989; Tomblin, 1989, 1990; Tomblin, Hardy, & Hein, 1991);
2. low maternal education (Paul, 1991; Rice et al., 1999; Tomblin, Records, et al., 1997; Tomblin, Smith, & Zhang, 1997); and
3. single-parent homes (Andrews, Goldberg, Wellen, Pittman, & Struening, 1995; Goldberg, McLaughlin, Grossi, Tytun, & Blum, 1992; Miller & Moore, 1990).

The cumulative risk model of development posits that adverse developmental outcomes can be predicted more accurately by combinations of—rather than single—risk factors (Sameroff, Seifer, Baldwin, & Baldwin, 1993; Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987). The premise is that the cumulative effect of multiple risks, rather than individual risk factors per se, accounts for developmental delays. In a study designed to test this hypothesis, Sameroff and colleagues (1993) identified a set of 10 social and family risk factors:

1. maternal mental health problems,
2. maternal anxiety,
3. maternal authoritarian childrearing attitudes,
4. poor mother–child interactions,
5. mother has less than a high school education,
6. head of the household has a semiskilled or an unskilled occupation,
7. minority ethnic status,
8. father absent,
9. several stressful life events in the previous year, and
10. large family size.

They reported that (a) all of these factors were individually related to children's IQ scores at 4 years of age and (b) a majority of them were still related to IQ at 13 years of age. Furthermore, the number of risk factors experienced by the child, as defined by the cumulative risk index, was a strong predictor of IQ at 4 years (accounting for approximately 58% of the variance) and at age 13 (accounting for 61% of the variance).

A study by Hooper, Burchinal, Roberts, Zeisel, and Neebe (1998) also provided evidence of the applicability of a cumulative risk model for predicting the cognitive and language performance of infants in a predominantly low socioeconomic status (SES) African American population. Hooper et al. identified a set of 10 social and family risk factors based on Sameroff's risk model:

1. poverty status,
2. maternal education less than high school,
3. household size,
4. unmarried mother,
5. stressful life events,
6. depressed maternal affect,
7. poor mother–infant interactions,
8. maternal IQ,
9. quality of the home environment, and
10. quality of the day-care environment.

All of the social and family risk factors were collected upon entry into the study, when infants were 6 to 12 months old. The authors found that 9 of the 10 risk factors (stressful life events was the exception) were modestly associated with the infant's cognitive and language outcomes. The cumulative risk index was modestly correlated with language measures (accounting for about 12% to 17% of the variance) but not the cognitive measure.

Evans and English (2002) provided evidence that low-income children are exposed to a substantially greater number of environmental risk factors than their middle-income counterparts. They identified three psychosocial stressors (violence, family turmoil, child–family separation) and three physical stressors (crowding, noise, low housing quality) as risk factors that could lead to negative outcomes. In their investigation of the environment of poverty, they found that only 20% of low-income children were exposed to no factors or one risk factor. Conversely, 61% of their middle-income sample was exposed to no factors or one risk factor. This finding suggests that the majority of low-income children are exposed to more adversities than their middle-income peers and are at a heightened risk for cognitive, behavioral, or social dysfunction.

A growing body of research has examined differences in the language development of children from different cultural and socioeconomic backgrounds and the implications of these differences for subsequent academic achievement. Robertson (1998) compared the phonological abilities of kindergarten children from families with high and low SES and found that the low-SES children performed significantly worse on a series of cognitive, linguistic, and prereading measures. A 2-year follow-up revealed that these children had not caught up with the children from the high-SES families. Burt, Holm, and Dodd (1999) also found an association between poor performance and low SES by assessing children's performance on several phonological tasks. In an attempt to explain the link between disadvantage and school failure, Hart and Risley (1995) examined the differences in the quantity of language addressed to children from different SES backgrounds in their first 2½ years of life. They reported that children from low-SES backgrounds were at a disadvantage because their parents or guardians talk to them less frequently; consequently, they have poorer vocabulary and communication skills than their higher-SES peers.

The primary purpose of this study was to examine the relationship between cumulative risks, measured at birth, and the language development of low-income children through the use of an electronic data linkage method. More specifically, our research aims were to investigate (a) the prevalence rates of various birth risk factors experienced by children from low-income families and (b) the cumulative effects of these risk factors on language development at 3 years of age for both boys and girls. The utility of birth records in helping target preventive interventions for at-risk children will be discussed in the context of these findings.

A primary contribution this study has to the practice of early intervention and special education is that it demonstrates how a developmental epidemiological approach can inform prevention efforts. This is particularly the case with children, who are largely dependent on adults to recognize and initiate treatment for their emotional, cognitive, or physical difficulties. These adults (particularly parents, day care providers, or pediatricians) may often fail to recognize early indicators of a disability or may view such indicators as a phase a child will outgrow. Many children thus do not receive treatment until their problems become incapacitating or significantly affect their relationships with others. Developmental epidemiology is a methodological approach that can greatly aid in this effort by identifying early risk factors for childhood problems, as well as the prevalence rates of these problems in the community. Several researchers have used a developmental epidemiological approach to identify children at birth who are most at risk for a future developmental disability (see Chapman, Scott, & Mason, 2002; Mason, Chapman, & Scott, 1999; Stanton-Chapman, Chapman, Bainbridge, & Scott, 2002; Stanton-Chapman, Chapman, & Scott, 2001). These studies identified specific factors that can put children at an increased risk for a developmental disability, but the researchers did not examine outcomes among preschool children or use standardized language assessment scores to identify at-risk children.

Method

The data for these analyses were the result of a collaborative effort between researchers at Peabody College at Vanderbilt University and the Office of Policy Planning and Assessment at the Tennessee Department of Health (TDH). In the current study, an electronic data linkage method was used to examine the relationship between multiple risk factors present at birth and the language development of 3-year-old children enrolled in Head Start programs in the Nashville, Tennessee, area.

Participants

The sample in the current study consisted of 853 children who were 3 years old, had been born in Tennessee, and were enrolled in a Head Start center in the Nashville area. Because families must meet low-income guidelines to qualify for Head Start, participants were necessarily drawn from a low-SES population. The parents of these children had previously given consent to participate in an ongoing project on early identification and intervention for children with behavioral and communication problems (Kaiser, Cai, Hancock, & Foster, 2002; Qi, Kaiser, Milan, & McLean, 2003). Although many of these children received intervention during the 5 years of the project, the current study reports only the initial 3-year-old screening data, which was obtained prior to the intervention phase of the study.

Procedure

Birth risk variables were derived from an electronic linkage of birth certificate records of all children born in Tennessee between January 1, 1991, and December 31, 1997 (N = 555,091), and 3-year-old children enrolled in Head Start centers (n = 964) who had previously been screened for language problems as part of an early identification and intervention study of children with behavioral and communication problems (Kaiser et al., 2002; Qi et al., 2003). Linkage was conducted with the Head Start data stored locally in Microsoft Access 2000, and we accessed the birth records remotely by connecting to a Microsoft SQL Server 2000 database at the TDH. To ensure confidentiality, one of the authors conducted all the linkages with the birth data on a TDH computer. As soon as the linkage was completed, all identifying information was removed, leaving only the nonidentifiable subject number that had been previously assigned in the analysis data set.

The two data sets were matched in a series of linkage attempts, with successful matches removed from each subsequent pass. Matches were made in two ways. First, exact matches were conducted automatically using Microsoft Access 2000. Second, visual matches occurred via manual selection from a list of potential matches displayed on a split screen using a Microsoft Access form. Visual matching allowed for consideration of cases where dates might have been transposed (e.g., 3/12/97 vs. 3/21/97) or names had been abbreviated or misspelled. The data linkage criteria and number of matches obtained at each pass were as follows:

1. exact match on child's first name, last name, and date of birth (n = 732);
2. exact match on child's last name and date of birth and visual match on child's first name (n = 73);
3. exact match on child's last name and visual match on child's date of birth and first name (n = 24); and
4. exact match on mother's first name and last name (maiden or current) and visual match on child's first name, last name, and date of birth (n = 24).

Overall, matching birth records were found for 853 children out of the original sample of 964 (88.5%). This relatively time-consuming method of manually resolving nonexact matches was chosen because there were only 232 unmatched cases remaining after the first pass. The remaining computer-assisted manually made matches were identified in a single morning. In general, it is not reasonable to manually scroll through potential matches for very large samples, so one could either use exact matches only or employ probabilistic linkage techniques (Jaro, 1995; Newcombe, 1988) to automatically identify the "close" matches found in a manual search. Specific decisions regarding linkage methods depend on the sample size, research question, and quality of the data.

Measures

Preschool Language Scale-3 (PLS-3; Zimmerman, Steiner, & Pond, 1992) is an individually administered standardized test for use with infants and children from birth through 6 years of age. The PLS-3 assesses young children's receptive and expressive language abilities using a Total Score and two subscales, Auditory Comprehension and Expressive Communication. Each of the two subscales contains 48 items, and the assessment results yield a raw score, a standard score, an age-equivalent score, and a percentile rank. The standardization sample for the PLS-3 consisted of 1,200 children and yielded reliability coefficients using Cronbach's alpha ranging from .47 to .88 for Auditory Comprehension, .68 to .91 for Expressive Communication, and .74 to .94 for the Total Score. Test–retest reliabilities ranged from .82 to .94 for 85 children randomly selected from the standardization sample. Research using the PLS-3 to assess low-SES preschool children has not revealed any clear source of bias in the instrument; however, children in this population do consistently score lower than the middle-SES normative sample (Qi et al., 2003).

In this study, a doctoral student in Vanderbilt's Special Education Program and two project staff members who held bachelor's degrees in education administered the PLS-3. Prior to adminstration, the project staff members and the doctoral student were trained on the measure by a licensed school psychologist. This training consisted of lectures on how to administer the PLS-3, practice administrations in which the fourth author observed each person administering the instrument to children not enrolled in our intervention study, and reliability administrations. Administration reliabilities ranged from 92% to 97%.

Variables

The outcome measures were the standardized Auditory Comprehension, Expressive Communication, and Total scores from the PLS-3. A cumulative risk summary variable was computed based on data from birth certificates provided by the TDH. Risk variables reflected the child's or family's status at the time of birth. In general, birth certificates have been shown to portray prenatal history and care variables accurately but to underreport complications when assessed via medical chart review. Two recent studies examined the accuracy of birth records data in detailing the presence (sensitivity or true positive rate) and absence (specificity or true negative rate) of conditions in the medical record (Dobie et al., 1998; Roohan et al., 2003). Because most prenatal conditions are rare, reported specificity of data abstracted from birth records was very high, typically 99% to 100% for most variables. Sensitivity varied widely (0%–100%) for maternal medical risk factors, indicating that when rare conditions were present, they were not always indicated on the birth certificate.

The summary cumulative risk variable was defined as the total number of the following risk factors: maternal (< 12 years' education, unmarried, tobacco use during pregnancy, presence of a medical history factor, complication of labor/delivery); paternal (< 12 years' education); and childbirth (low birthweight, preterm birth, abnormal newborn condition). The medical history factor component of the cumulative risk score reflected any one of a number of maternal conditions, including anemia, diabetes, and eclampsia. Due to the relatively low prevalence of specific factors and known underreporting issues, medical history data were scored as a group, adding 1 to the cumulative risk score, regardless of the number of specific medical history factors present. Similarly, abnormal newborn conditions (e.g., anemia, meconium aspiration syndrome, assisted ventilation) and labor or delivery complications (e.g., placenta previa, breech presentation, fetal distress) refer to aggregate variables from the birth record scored as a single risk factor component of the cumulative risk variable.

Data Analysis

The data linkage methodology in the current study provided a unique opportunity to clearly define the study sample in comparison to a broader sample of children enrolled in Head Start because complete language data existed for children for whom a matching birth record was not found. First, a two-tailed chi-square analysis was used to compare the linked and unlinked samples on several key demographic variables. Second, the prevalence of individual risk factors in the linked sample was compared to a county-wide comparison group. Descriptive statistics (sample size, mean, and standard deviation) for boys and girls were computed next for each level of the cumulative risk variable for the PLS-Total, Auditory, and Expressive scores. A simple linear regression was also computed for boys and girls to test significance of the cumulative risk variable at predicting all three scores. Finally, the rate of occurrence of "low language" by gender was computed for each level of the cumulative risk variable.

Results

Linked Versus Unlinked Comparison

Because this study included only Tennessee birth records, any child who was not born in Tennessee would necessarily be in the unlinked group (i.e., not included in the current linked sample). Children in the linked sample were more likely to be African American and to have parents who did not complete high school (see Table 1). Compared to children in the unlinked sample, children in the linked sample also had lower PLS-3 Auditory and Total scores (see Table 2). Given the comprehensive data linkage procedure employed, linked versus unlinked sample differences appeared to reflect differences in families' mobility rather than bias in the linkage algorithm.

Prevalence of Risk Factors

Head Start children in the current study were exposed, on average, to 2.3 (SD = 1.3) birth risk factors. By comparison, in 1994, the median year of the Head Start sample, the mean number of birth risk factors for children born in Davidson County (which includes the Nashville area where the Head Start centers in this study were located) was 1.6 (SD = 1.5) for both boys and girls (see Table 3). Only 5.9% of the current sample had none of the 9 risk factors compared to 27.0% of the Davidson County births. The percentage of children enrolled in Head Start with 3 or more risk factors (39.2%) was also higher than that of Davidson County (24.1%). It should be noted that the comparison included all births in the county. Thus, differences between the county totals and children enrolled in Head Start would have been greater had it been possible to remove Davidson County children enrolled in Head Start from the county-wide comparison group.

Cumulative Risk Effects

The mean and standard deviations for the PLS-3 Total Score and PLS-3 Auditory and Expressive subscales at each level of cumulative risk for boys and girls are presented in Table 4. Separate linear regressions were then performed for each gender, predicting PLS-3 scores based on the summary cumulative risk variable. For girls, the linear model was significant for the PLS-3 Total Score, $t(400) = -5.32$, $p < .001$; Auditory score, $t(400) = -4.94$, $p < .001$; and Expressive score, $t(400) = -4.56$, $p < .001$). Only the Total Score, $t(451) = -2.55$, $p = .011$, and Auditory score, $t(451) = -3.20$, $p = .002$, were significant for

TABLE 1. Demographics of Linked Versus Unlinked Samples of Head Start Children

Characteristic	Unlinked *n*	Unlinked %	Linked *n*	Linked %	χ^2	*df*	*p*
Race							
African American	92	82.9	783	91.8	32.853	2	< .001
Caucasian	8	7.2	59	6.9			
Other	11	9.9	11	1.3			
Gender							
Boy	53	48.6	452	53.0	0.739	1	.390
Girl	56	51.4	401	47.0			
Mother married							
Yes	25	24.0	132	17.8	2.336	1	.126
No	79	76.0	609	82.2			
Maternal education							
< 12 yrs	12	11.8	187	25.1	12.582	2	.002
High school diploma	38	37.3	293	39.3			
> 12 yrs	52	51.0	265	35.6			
Paternal education							
< 12 yrs	12	14.8	149	26.2	13.173	2	.001
High school diploma	38	46.9	300	52.7			
> 12 yrs	31	38.3	120	21.1			

TABLE 2. Linked Versus Unlinked PLS-3 Scores for Study Children at 3 Years of Age

PLS-3 Score	Unlinked *M*	Unlinked *SD*	Linked *M*	Linked *SD*	ANOVA *F*	ANOVA *df*	ANOVA *p*
Auditory Comprehension	90.9	14.9	86.2	12.0	14.008	(1, 962)	< .001
Expressive Communication	90.7	13.4	88.4	11.9	3.473	(1, 962)	.053
Total	89.8	14.5	86.0	12.1	9.233	(1, 962)	.002

Note. PLS-3 = *Preschool Language Scale-3* (Zimmerman, Steiner, & Pond, 1992).

boys. Cumulative risk accounted for 6.6% of the variance in the girls' Total Score, 5.8% of the variance in their Auditory score, and 5.0% of the variance in their Expressive score. The corresponding percentages of variance accounted for among boys were 1.4%, 2.2%, and 0.5%, respectively. As indicated previously, only the Expressive result for boys was not significant.

Because the primary focus of the current study was predicting poor language development rather than explaining overall variance in language, the children were then grouped into either a low-language group or a comparison group. *Low language* was defined as having a PLS-3 Total Score more than 1.5 *SD* below the normative sample or both PLS-3 Auditory and Expressive scores more than 1.3 *SD* below the normative sample. When no birth risk factors were present, 19.2% of the girls and 33.3% of the boys were identified has having low language. This rate increased as the number of risk factors increased for both genders. When five or more risk factors were present, 67.9% of the boys and 53.8% of the girls fell into the low-language group. Low language was more prevalent in boys than in girls regardless of the number of risk factors present (see Figure 1).

Discussion

The current study investigated the relationship between cumulative risks, measured at birth, and the language development of low-income children through the use of an

TABLE 3. Sample Birth Characteristics for Study Samples

Characteristic	Current sample[a] n	Current sample[a] Valid %	Davidson County (1994)[b] n	Davidson County (1994)[b] Valid %
Maternal risk factors				
< 12 yrs education	334	39.2	1,896	23.3**
Unmarried	703	82.4	3,216	39.4**
Prenatal tobacco use	88	10.3	1,205	14.8
Medical history factor	114	13.4	1,013	12.4
Labor/delivery complication	270	31.7	2,564	31.4
Paternal risk factor				
< 12 yrs education	141	26.9	1,055	15.9**
Childbirth risk factors				
Low birthweight	122	14.4	793	9.7
Preterm birth	152	17.8	865	10.8*
Congenital anomaly	3	0.4	66	0.8
Abnormal newborn condition	40	4.7	305	3.7

[a]$N = 853$. [b]$N = 8{,}171$.
* $p < .01$. ** $p < .001$.

TABLE 4. Mean PLS-3 Total and Subscale Scores for Children with 0 to 7 Risk Factors

	Boys							Girls						
		Total		Aud		Exp			Total		Aud		Exp	
Risk factors	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
0	24	90.4	15.8	92.0	16.1	90.5	14.3	26	96.4	15.4	95.1	13.5	97.9	15.9
1	107	85.4	11.9	86.0	11.7	87.7	11.9	90	88.2	11.3	88.1	10.9	90.4	12.3
2	143	84.1	10.5	84.8	11.1	86.5	9.9	129	89.1	11.9	88.9	11.3	91.3	12.4
3	99	83.3	12.0	83.6	11.7	85.7	11.5	84	88.7	12.3	88.7	12.6	90.9	12.3
4	52	82.8	10.1	83.5	11.8	85.4	8.8	46	81.8	10.3	82.1	10.7	85.0	10.0
5	20	83.5	14.1	81.5	12.8	88.6	15.3	19	80.8	9.9	82.2	10.7	83.1	10.1
6	7	81.3	5.4	80.7	7.3	85.4	4.4	4	78.5	9.3	80.0	10.2	81.0	7.3
7	0		—		—		—	3	74.0	1.7	71.0	1.0	82.0	1.7
Total	452	84.4	11.6	84.8	11.9	86.8	11.1	401	87.8	12.3	87.8	11.9	90.2	12.5

Note. PLS-3 = *Preschool Language Scale-3* (Zimmerman, Steiner, & Pond, 1992); Total = Total Score; Aud = Auditory Comprehension Subscale Score; Exp = Expressive Communication Subscale Score.

electronic data linkage method. The specific goals were to examine (a) the prevalence of birth risk factors experienced by children from low-income families and (b) the cumulative effects of these risk factors on language development at 3 years for boys and girls.

Consistent with previous research (Evans & English, 2002), children in this Head Start–based sample had been exposed to more birth risk factors than children in the overall population from which they were drawn. More than 94% of the children in this sample had been exposed to at least one birth risk factor. According to Qi et al. (2003), language scores for children living in poverty are generally lower, irrespective of the number of risks. In the current sample, the mean PLS-3 Total Score was 86.0 (range = 50–131), which was considerably lower than the mean score from the normative sample

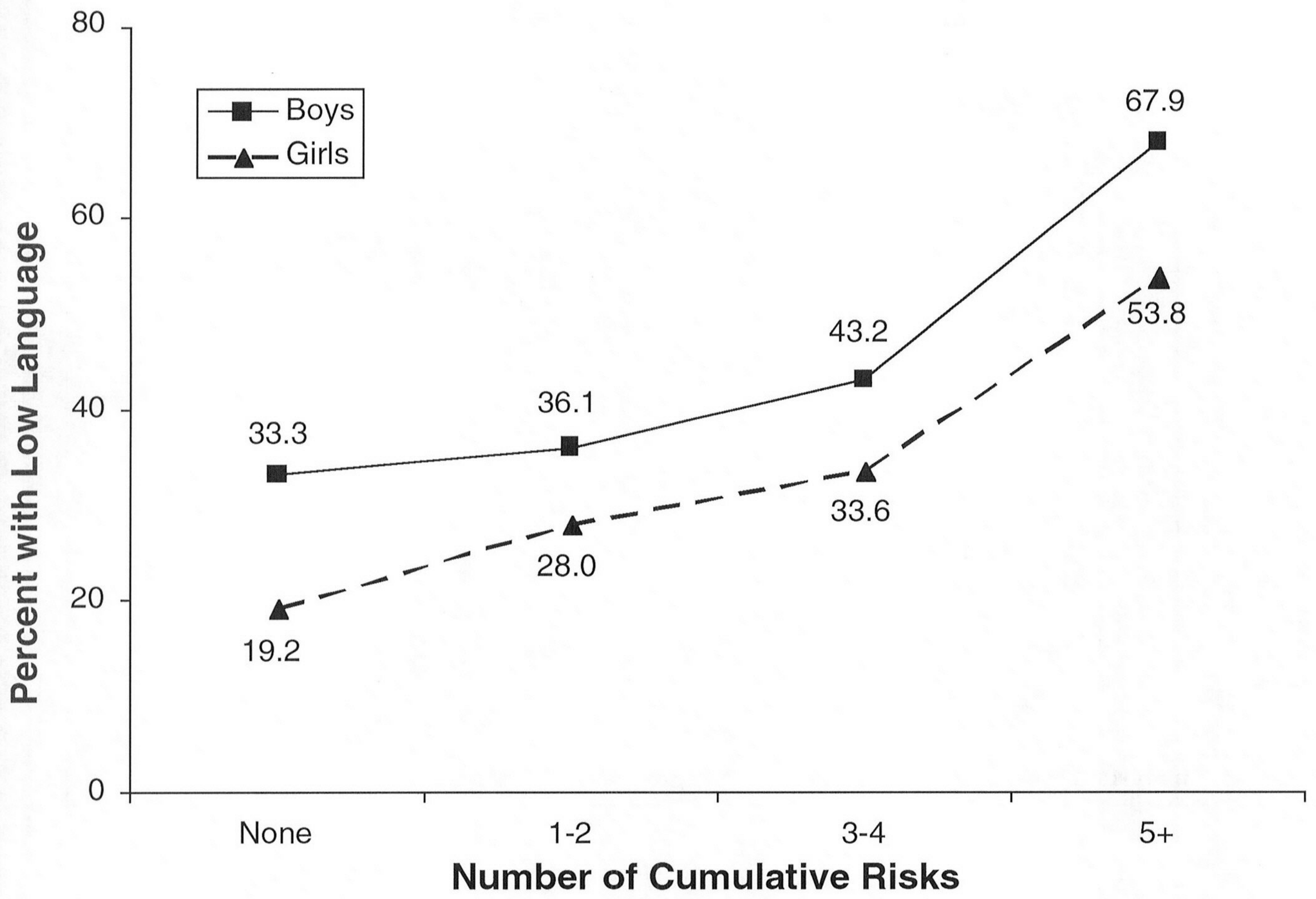

FIGURE 1. Percentage of Head Start children with poor language development by number of cumulative risks measured at birth.

(100.0), as reported in the PLS-3 manual (Zimmerman et al., 1992). Each risk factor reported in the current study, in isolation, has been shown to be associated with adverse developmental outcomes (Andrews et al., 1995; Goldberg et al., 1992; Halsey, Collin, & Anderson, 1993; Miller & Moore, 1990; Stanton-Chapman et al., 2002; Vohr, Garcia-Coll, & Oh, 1988). The accumulation of multiple risk factors therefore appears to increase the negative effects of poverty.

For example, even within this low-income sample, as the number of risk factors increased, language scores decreased (see Table 4). When no risk factors were present, the mean PLS-3 Total Scores for boys (90.4, *SD* = 15.8) and girls (96.4, *SD* = 15.4) were comparable to those of the PLS-3 normative population. Among the children with the highest number of risk factors (six or more), the mean PLS-3 Total Score was substantially lower than the normative mean for both boys (81.3, *SD* = 5.4) and girls (76.6, *SD* = 7.1). Lower scores among boys were expected because language impairments are more prevalent in boys than in girls (Resnick et al., 1998; Stanton-Chapman et al., 2002; Weindrich, Jennen-Steinmetz, Laucht, Esser, & Schmidt, 2000).

Cumulative risk had a greater association with language scores among girls. On average, a girl's PLS-3 Total Score decreased by 2.3 points with each risk factor, whereas the average decrease for boys was 1.1 points. Overall, cumulative risk factors accounted for just 3.4% of the variance in the PLS-3 Total Score. This finding is rather surprising, given the relatively large effects associated with each of the individual components of cumulative risk reported in population-based studies of language disorders (Andrews et al., 1995; Stanton-Chapman et al., 2002). Given that girls, in general, are less vulnerable than boys, it may be that those girls who do show constitutional vulnerability are even more affected by the presence of several risk factors and thus have lower PLS-3 scores.

Compared to the general population, however, the low-income children in this study were exposed to a greater number of risk factors, faced these risk factors in the context of poverty, and tended to have lower language scores regardless of the number of risk factors. The PLS-3 scores in this sample were distributed around a mean (86.0) that was nearly 1 *SD* below the expected norm and is very close to the value that would typically prompt a referral for language intervention. With scores so close to critical cut-offs, these relatively small effects on overall language can have a large impact on the number of children with poor language development. For example, 17% of the sample in this study was exposed to four or more risk factors, which resulted in a PLS-3 Total Score decrease of 4.4 and 9.2 points, respectively, for boys and girls, based on the regression equation. Thus, a child who comes from a low-SES background may experience more detrimental effects from exposure to several risk factors than a child from a more affluent background with the same number of stressors because his or her language development may already be somewhat delayed.

The current investigation has several limitations, most of which are due to restrictions in the sample. There were very few non–African American participants, which limited the extent to which the results can be generalized to preschoolers of other ethnic groups. Second, the sample selection procedures limited generalizability of the results to other low-income samples not recruited through Head Start. Third, only one measure of language (the PLS-3) was used to assess a child's language skills. Multiple sources of information (in particular, actual language samples) may provide a more accurate description of a child's language abilities than a single standardized measure. Finally, future studies may want to examine historical birth-risk data in the context of current status measures of both risk and protective factors, such as maternal stress and social support. Other researchers have demonstrated that recovery from risk factors, whether partial or complete, may occur due to experiences that take place well after the initial risk experience, such as a move outside the inner city (Osborn, 1980), involvement with positive peer groups (Rowe, Wouldbroun, & Gulley, 1994), and positive turning points at which a negative life trajectory is turned into a more adaptive one (e.g., single parent gets married, enrollment in a positive school setting; Rutter, 1996). Findings such as these point to the importance of studying risk as a dynamic variable.

Despite these limitations, data linkage using existing administrative data sets such as birth records can be a useful tool to support early intervention and prevention efforts. Birth certificates are readily available and can serve as a means of early identification as well as a complement to measures collected when the child is older. Researchers can obtain access to historical data without the time and cost of prospective longitudinal studies, and detailed information about the birth may be obtained without relying on parent recall. Further work with larger samples needs to be done to determine the sensitivity and specificity of a birth record–based risk-screening tool that could help select those children most likely to require language intervention services. Receipt of early intervention services for low-income children exposed to multiple risks could help facilitate the prevention or amelioration of later language disabilities.

In addition to child-focused services such as speech and language therapy, intervention programs need to consider strategies for reducing the effects of the various risk factors these children experience. Several key risk factors in this study were markers for more proximal aspects of the childrearing environment rather than causal determinants. For example, awarding a diploma to a mother who did not finish high school will not increase her knowledge of childrearing or improve the quality of her interactions with her child; however, these skills can be addressed through intervention. Interventions therefore should focus on the family and provide parenting programs that include an educational component (e.g., literacy skills, job training, parenting skills) to reduce the effects of low maternal and paternal education on a child's language development. In addition, intervention programs should have direct links to community-based agencies that could assist low-income families in improving their life conditions, help them move out of poverty, and give them a social network that understands their experiences and helps them to work through their situations. ◆

AUTHORS' NOTE

Derek A. Chapman was employed with the Tennessee Department of Health when this study was conducted.

REFERENCES

Adams, C. D., Hillman, N., & Gaydos, G. R. (1994). Behavioral difficulties in toddlers: Impact of sociocultural and biological risk factors. *Journal of Clinical Child Psychology, 23*, 373–381.

Andrews, H., Goldberg, D., Wellen, N., Pittman, B., & Struening, E. (1995). Prediction of special education placement from birth certificate data. *American Journal of Preventative Medicine, 11*(3), 55–61.

Attar, B., Guerra, N., & Tolan, P. (1994). Neighborhood disadvantage, stressful life events, and adjustments in urban elementary school children. *Journal of Clinical Child Psychology, 23*, 391–400.

Beitchman, J. H., Hood, J., & Inglis, A. (1990). Psychiatric risk in children with speech and language disorders. *Journal of Abnormal Child Psychology, 18*, 283–296.

Brooks-Gunn, J. (1990). Identifying the vulnerable young child. In D. E. Rogers & E. Ginzberg (Eds.), *Improving the life chances of children at risk* (pp. 104–124). Boulder, CO: Westview.

Brooks-Gunn, J., Klebanov, P., & Liaw, F. (1995). The learning, physical, and emotional environment of the home in the context of poverty: The infant health and development program. *Children and Youth Services Review, 17*, 251–276.

Burt, L., Holm, A., & Dodd, B. (1999). Phonological awareness skills of 4-year-old British children: An assessment and developmental data. *International Journal of Language and Communication Disorders, 34*, 311–335.

Chapman, D. A., Scott, K. G., & Mason, C. A. (2002). Early risk factors for mental retardation: The role of maternal age and maternal education. *American Journal on Mental Retardation, 107*(1), 46–59.

Dobie, S. A., Baldwin, L., Rosenblatt, R. A., Fordyce, M. A., Andrilla, C. H., & Hart, G. L. (1998). How well do birth certificates describe the pregnancies they report? The Washington State experience with low-risk pregnancies. *Maternal and Child Health Journal, 2,* 145–154.

Duncan, G., Klebanov, P., & Brooks-Gunn, J. (1994). Economic deprivation and early childhood development. *Child Development, 65,* 296–318.

Evans, G. W., & English, K. (2002). The environment of poverty: Multiple stressor exposure, psychophysiological stress, and socioemotional adjustment. *Child Development, 73,* 1238–1248.

Fazio, B. B., Naremore, R. C., & Connell, P. J. (1996). Tracking children from poverty at-risk for specific language impairment: A 3-year longitudinal study. *Journal of Speech and Hearing Research, 39,* 611–624.

Finkelstein, N. W., & Ramey, C. T. (1980). Information from birth certificates as a risk index for educational handicap. *American Journal of Mental Deficiency, 84,* 546–552.

Goldberg, D., McLaughlin, M., Grossi, M., Tytun, A., & Blum, S. (1992). Which newborns in New York City are at-risk for special education placement? *American Journal of Public Health, 82,* 438–440.

Gore, S., & Eckenrode, J. (1996). Context and process in research on risk and resilience. In R. J. Haggerty, L. Sherrod, N. Garmezy, & M. Rutter (Eds.), *Stress, risk, and resilience in children and adolescents* (pp. 19–63). New York: Cambridge University Press.

Halpern, R. (1993). Poverty and infant development. In C. Zeanah (Ed.), *Handbook of infant mental health* (pp. 73–86). New York: Guilford Press.

Halpern, R. (2000). Early childhood intervention for low-income children and families. In J. P. Shonkoff & S. J. Meisels (Eds.), *Handbook of early childhood intervention* (2nd ed., pp. 361–386). Cambridge, England: Cambridge University Press.

Halsey, C. L., Collin, M. F., & Anderson, C. L. (1993). Extremely low birth weight children and their peers: A comparison of preschool performance. *Pediatrics, 91,* 807–811.

Hart, B., & Risley, R. R. (1995). *Meaningful differences in the everyday experience of young American children.* Baltimore: Brookes.

Hoff-Ginsberg, E. (1998). The relation of birth order and socioeconomic status to children's language experience and language development. *Applied Psycholinguistics, 19,* 603–629.

Hooper, S. R., Burchinal, M. R., Roberts, J. E., Zeisel, S., & Neebe, E. C. (1998). Social and family risk factors for infant development at one year: An application of the cumulative risk model. *Journal of Applied Developmental Psychology, 19*(1), 85–96.

Jaro, M. A. (1995). Probabilistic linkage of large public health data files. *Statistics in Medicine, 14,* 491–498.

Kaiser, A. P., Cai, X., Hancock, T. B., & Foster, E. M. (2002). Teacher-reported behavior problems and language delays in boys and girls enrolled in Head Start. *Behavior Disorders, 28*(1), 23–39.

Klerman, L. V. (1991). The health of poor children: Problems and programs. In A. C. Huston (Ed.), *Children in poverty* (pp. 136–157). New York: Cambridge University Press.

Laucht, M., Esser, G., Baving, L., Gerhold, M., Hoesch, I., Ihle, W., et al. (2000). Behavioral sequelae of perinatal insults and early family adversity at 8 years of age. *Journal of the American Academy of Child & Adolescent Psychiatry, 39,* 1229–1237.

Levin, H. M. (1991). Educational acceleration for at-risk children. In A. C. Huston (Ed.), *Children in poverty* (pp. 222–240). New York: Cambridge University Press.

Liaw, F., & Brooks-Gunn, J. (1994). Cumulative familial risks and low birthweight children's cognitive and behavioral development. *Journal of Clinical Child Psychology, 23,* 360–372.

Mason, C. A., Chapman, D. A., & Scott, K. G. (1999). Risk factors for severe emotional disabilities and emotional handicaps (SED/EH): An epidemiological perspective. *American Journal of Community Psychology, 27,* 357–381.

McLoyd, V. C. (1990). The impact of economic hardship on Black families and development. *Child Development, 61,* 311–346.

McLoyd, V. C., & Wilson, L. (1991). The strain of living poor: Parenting, social support, and child mental health. In A. C. Huston (Ed.), *Children in poverty* (pp. 105–135). New York: Cambridge University Press.

Miller, B., & Moore, K. A. (1990). Adolescent sexual behavior, pregnancy, and parenting: Research findings through the 1980s. *Journal of Marriage and the Family, 52,* 1025–1044.

Neils, J., & Aram, D. (1986). Family history of children with developmental language disorders. *Perceptual and Motor Skills, 63,* 655–658.

Newcombe, H. B. (1988). *Handbook of record linkage: Methods for health and statistical studies, administration, and business.* New York: Oxford University Press.

Osborn, S. G. (1980). Moving home, leaving London and delinquent trends. *British Journal of Criminology, 20*(1), 54–61.

Paul, R. (1991). Profiles of toddlers with slow expressive language development. *Topics in Language Disorders, 11*(1), 1–13.

Pine, J. M. (1995). Variation in vocabulary development as a function of birth order. *Child Development, 66,* 272–281.

Qi, C. H., Kaiser, A. P., Milan, S. E., & McLean, Z. Y. (2003). The performance of low income, African American children on Preschool Language-3 Scale. *Journal of Speech, Language, and Hearing Research, 23*(4), 188–216.

Resnick, M. B., Gomatam, S. V., Carter, R. L., Ariet, M., Roth, J., Kilgore, K. L., et al. (1998). Educational disabilities of neonatal intensive care graduates. *Pediatrics, 102,* 308–314.

Rice, M. L., Spitz, R. V., & O'Brien, M. (1999). Semantic and morphosyntactic language outcomes in biologically at-risk children. *Journal of Neurolinguistics, 12,* 213–234.

Robertson, K. L. (1998). Phonological awareness and reading achievement of children from differing soci-economic backgrounds. *Dissertation Abstracts International Section A: Humanities and Social Sciences, 58* (8-A), 3066.

Roohan, P. J., Josberger, R. E., Acar, J., Dabir, P., Feder, H. M., & Gagliano, P. J. (2003). Validation of birth certificate data in New York State. *Journal of Community Health, 28,* 335–346.

Rowe, D. C., Wouldbroun, E. J., & Gulley, B. L. (1994). Peers and friends as nonshared environmental influences. In E. M. Hetherington, D. Reiss, & R. Plomin (Eds.), *Separate social worlds of siblings* (pp. 159–173). Hillsdale, NJ: Erlbaum.

Rutter, M. (1996). Transitions and turning points in developmental psychopathology: As applied to the age span between childhood and mid-adulthood. *International Journal of Behavioral Development, 19,* 603–626.

Sameroff, A. J., Seifer, R., Baldwin, A., & Baldwin, C. (1993). Stability of intelligence from preschool to adolescence: The influence of social and family risk factors. *Child Development, 64*(1), 80–97.

Sameroff, A. J., Seifer, R., Barocas, R., Zax, M., & Greenspan, S. (1987). Intelligence quotient scores of 4 year old children: Social and environmental risk factors. *Pediatrics, 79,* 343–350.

Siegel, L. S., Saigal, S., Rosenbaum, P., Morton, R. A., Young, A., Berenbaum, S., et al. (1982). Predictors of development in preterm and full-term infants: A model for detecting the at-risk child. *Journal of Pediatric Psychology, 7,* 135–147.

Spitz, R. V., Tallal, P., Flax, J., & Benasich, A. A. (1997). Look who's talking: A perspective study of familial transmission of language impairments. *Journal of Speech, Language, and Hearing Research, 40,* 990–1001.

Stanton-Chapman, T. L., Chapman, D. A., Bainbridge, N. L., & Scott, K. G. (2002). Identification of early risk factors for language impairment. *Research in Developmental Disabilities, 23,* 390–405.

Stanton-Chapman, T. L., Chapman, D. A., & Scott, K. G. (2001). Prediction of learning disabilities from information available on birth certificate records. *Journal of Early Intervention, 24,* 193–206.

Tallal, P., Ross, R., & Curtiss, S. (1989). Familial aggregation in specific language impairment. *Journal of Speech and Hearing Research, 54,* 167–173.

Tomblin, J. B. (1989). Familial concentration of developmental language impairment. *Journal of Speech and Hearing Disorders, 54,* 287–295.

Tomblin, J. B. (1990). The effect of birth order on the occurrence of developmental language impairment. *British Journal of Disorders of Communication, 25,* 77–84.

Tomblin, J. B., Hardy, J. C., & Hein, H. A. (1991). Predicting poor communication status in preschool children using risk factors at birth. *Journal of Speech and Hearing Research, 34,* 1096–1105.

Tomblin, J. B., Records, N. L., Buckwalter, P., Zhang, X., Smith, E., & O'Brien, M. (1997). Prevalence of speech impairment in kindergarten children. *Journal of Speech, Language, and Hearing Research, 40,* 1245–1260.

Tomblin, J. B., Smith, E., & Zhang, X. (1997). Epidemiology of specific language impairment: Prenatal and perinatal risk factors. *Journal of Communication Disorders, 30,* 325–344.

Vohr, B. R., Garcia-Coll, C. T., & Oh, W. (1988). Language development of low birth weight infants at 2 years. *Developmental Medicine and Child Neurology, 30,* 608–615.

Weindrich, D., Jennen-Steinmetz, C., Laucht, M., Esser, G., & Schmidt, M. H. (2000). Epidemiology and prognosis of specific disorders of language and scholastic skills. *European Child and Adolescent Psychiatry, 9,* 186–194.

Wells, G. (1980). Language, literacy, and education. In G. Wells (Ed.), *Learning through interaction* (pp. 240–276). New York: Cambridge University Press.

Zimmerman, I. L., Steiner, V., & Pond, R. E. (1992). *Preschool language scale-3.* San Antonio, TX: Psychological Corp.