Parental, Gestational, and Birth-Related Risk Factors for Low Cognitive Functioning at 9 and 24 Months of Age

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Abstract

OBJECTIVE. Early identification of low cognitive functioning is important to effectively target intervention efforts. Optimal screening regimens would encompass the full range of relevant risk factors, however the degree of risk for cognitive delay associated with specific biologic and social characteristics in infancy and young childhood is not well-understood. This study quantifies the extent to which characteristics of a child's gestation, conditions at birth, and socio-demographic characteristics are associated with elevated risk of low cognitive functioning at 9 and 24 months of age.

METHODS. Birth certificate and child assessment data are analyzed from the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), a new nationally representative cohort study of children born in 2001. The analytic sample includes 3,896 singleton children and 891 non-singleton children. Multivariate logistic regression models were estimated separately for singletons and non-singletons to examine the association of socio-demographic characteristics with low cognitive performance at 9 and 24 months on a modified version of the Bayley Scales of Infant Development. Additional logistic models evaluated whether gestational and birth-related factors mediated this association.

RESULTS. In multivariate models, gestational and birth characteristics are strongly associated with low cognitive functioning at 9 months, including very-low birthweight (OR=22.8), moderately-low birthweight (OR=4.4), very preterm delivery (OR=4.2), and moderately preterm delivery (OR=2.6). The size of these effects declines sharply by 24 months, however, and at that point they are similar in magnitude to the effects for sociodemographic factors including low maternal education (less than HS as an adult; OR=2.0), low income (OR=2.0), and nonwhite race/ethnicity (African American OR=2.0; Hispanic OR=2.5). Gestational and birth characteristics do not mediate the observed associations between sociodemographic factors and low cognitive functioning at 24 months.

CONCLUSIONS. Both biophysical and socio-demographic factors elevate risks for poor cognitive functioning in infancy and young childhood. Because the socio-demographic effects on risk of cognitive delay do not appear to operate via gestational and birth characteristics but rather occur over and above any such causal mechanisms, it is important for pediatricians to screen for socio-demographic risks.

Further investigation of the processes through which social disadvantage adversely affects early childhood development is needed.

Children with low cognitive functioning and other developmental delays are commonly seen by pediatricians and other primary care practitioners.[1] American Academy of Pediatrics policy[2] calls for pediatricians to maintain and update their knowledge about the risk factors for developmental disabilities and to use this knowledge to systematically conduct screenings of all infants and toddlers. Systematic screenings are important in order to more effectively target early intervention efforts which, in turn, can help maximize a delayed child's subsequent cognitive growth.[3] For screening regimens to produce optimal results, however, they must encompass the full range of relevant factors and identify patterns among those factors that signify elevated risk.

One general set of risk factors for low cognitive functioning includes the child's biophysical characteristics, and in particular the conditions of the child's gestation (e.g., whether the mother smoked or drank alcohol during pregnancy) and birth (e.g., whether the child was born with low or very low birthweight; whether there were complications at delivery). For instance, Stein et al.[4] reported that even moderately low birth weight children were at significantly greater risk for cognitive disability than normal birth weight children. Resnick et al.[5] found that birth weight, congenital anomalies, and complications of labor predicted the occurrence of learning disabilities. Stanton-Chapman et al.'s[3] analyses indicated that children with low APGAR scores were about twice as likely to later be identified as having specific language impairments. Pediatricians recently reported that they are most likely to initiate a screening for developmental delay when a child's case history includes a gestational or birth condition risk factor.[6]

Yet there is another general set of risk factors for low cognitive functioning, namely the child's socio-demographic characteristics. This set includes the child's demographic characteristics (e.g., his or her sex, racial/ethnic heritage) and the family's social characteristics (e.g., parents' educational attainment, living arrangements, household income, and parenting skills and resources). For example, Katusic, Colligan, Barbaresi, Schaid, and Jacobsen[7] found that boys were two to three times more likely to be learning disabled than girls. Smith, Brooks-Gunn, and Klebanov[8] found that children living in poverty scored much lower on measures of verbal ability, mathematics skill, and word recognition.

To date, few studies have sought to inform pediatricians on the extent to which particular biophysical or socio-demographic risks independently elevate a child's risk for cognitive delay. This is because very few investigations have attempted to quantify the effects for all of these general sets of factors when predicting the occurrence of low cognitive functioning.[9 10 11] This is problematic, in that biophysical and socio-demographic risk factors are already known to correlate[12, 13] For instance, African-American women are more likely to smoke than White women at older reproductive ages,[14] and also to exhibit a stronger link between cigarette smoking and preterm birth.[15] Failing to account for a child's socio-demographic background, for example, may lead to biased estimates of impact of the child's particular birth conditions on his or her cognitive growth and, in so doing, contribute to less accurate screening for developmental delay.[16]

There are additional limitations of the extant literature. Most studies have relied on relatively small samples. For instance, Kilbride et al.'s[17] study on the effects of extremely low birth weight was based on data from only 25 such children. Use of small samples may yield less accurate estimates of a particular factor's impact, while also limiting the generalizability of the study's findings. Few studies have analyzed the effects of gestation, birth conditions, and a child's socio-demographic characteristics and family conditions on his or her cognitive development during or soon after infancy. Instead, most studies have focused on predicting an older child's cognitive functioning at or after school entry.[3] Yet intervention efforts that are successfully directed by a medical professional during a child's first few years may result in the child making both substantial and long-term cognitive gains.[18] In addition, few studies have analyzed the effects of the different sets of factors using samples of non-singletons. Doing so is important in order to determine the extent to which these risk factors differ between singleton and non-singleton children.

The purpose of this paper is to quantify the extent to which characteristics of a child's gestation, conditions at birth, socio-demographic background, and family environment, considered both separately and collectively, are associated with elevated risk of poor cognitive functioning. We expand upon previous research in using a new, nationally representative dataset, the Early Childhood Longitudinal

Study Birth Cohort (ECLS-B). The ECLS-B includes complete birth certificate data, information gathered from parents, and direct assessment of children's mental and motor proficiency. This study identifies a range of socio-demographic characteristics and gestational and birth-related risk factors that are associated with low cognitive functioning at 9 and 24 months of age. Because twin and higher order multiples may experience unique risk patterns, we report results of analyses performed separately for singleton and non-singleton children.

Data and Research Methods

<u>Sample</u>

We use data from the ECLS-B, a nationally representative, longitudinal cohort study of children born in 2001. The sample is based on birth certificate records and includes oversamples of Asian and Pacific Islanders, American Indian and Alaska Natives, low birthweight (1,500-2,500 grams) and very low birthweight (less than 1,500 grams) children, and twins. At approximately 9 months (2001-2002) and 24 months after the child's birth (2003), ECLS-B field staff administered developmental assessments of the children and interviewed the children's parents. In practice, however, the 9-month data were collected when the children were between the ages of 6 and 22 months.

We restrict our analytic sample to those children with complete data on the study variables and children for whom the 9-month developmental assessments were measured when the children were between 8 and 10 months old.[i] In addition, we omit Native American children because of sample size limitations (singleton $N = 42$, non-singleton $N = 7$). This yields a final sample of 3,896 singleton children and 891 non-singleton children with data in both the 9-month and 24-month survey waves.

<u>Measures</u>

Cognitive Development Limitations. Our dependent variable derives from the mental scale of the Bayley Short Form—Research Edition (BSF-R), a modified version of the Bayley Scales of Infant

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[i] Relative to the full ECLS-B sample, our analytic sample has an overrepresentation of non-Hispanic White children and children with either a medical or behavioral risk present during the pregnancy, but fewer very low birth weight children, children with mothers aged 18 and older who did not complete high school, Hispanics, and Asians classified as either Japanese, Chinese, Korean or Indian.

Development, Second Edition BSID-II; [19] [ii] The BSF-R mental score was based on trained interviewers' direct assessments of children's age-appropriate cognitive development as manifested in memory, habituation, preverbal communication, problem solving and concept attainment. The interviewers asked all children to complete 13 specific tasks (e.g., "turn pages in a book," "look for contents of a box," "put three cubes in a cup," "respond to a spoken request").[iii] Low-scoring children were then asked to complete an additional 9 basal items (e.g., "play with a string," "vocalize three different vowel sounds," "retain two cubes for 3 seconds"). High-scoring children were asked to complete an additional 9 ceiling items (e.g., "retrieve a toy," "use words to make wants known," "put nine cubes in a cup").[19] The IRT reliability coefficient for the BSF-R mental scale at 9 months was 0.80.[19] The mean correlation between all 9-month observations on the BSF-R mental scale was .79. In general, there is little, if any evidence of appreciable bias in the BSF-R mental scale, but small biases favor girls, children from higher income families, and full term infants.[19]

Our dependent variable is a dichotomous variable for which children scoring in the lowest 10 percent of the BSF-R mental scale IRT score distribution were given a value of 1, and all others were coded 0.

Child Age. Child age in months was included to account for increases in Bayley scores with age.

Child Sex. Females were the reference category, with male children coded as 1.

Maternal Education. Based on data provided on the child's birth certificate, mother's education was measured as a series of dummy variables with college graduates as the reference category. The other categories are as follows: some college experience (but no degree); high school graduate; and less than high school. Those with less than a high school degree were subdivided into two groups: those aged 18

[ii] Regarding the psychometric properties of the Bayley scales, the BSID-II shows moderate to strong correlations with other standard assessments, such as the McCarthy Scales of Children's Abilities and the Wechsler Preschool and Primary Scale of Intelligence-Revised.[20] The original BSID-II and the BSF-R scale metrics are strongly related, such the equated tests scores appear fairly consistent across the entire range of the ability distribution.[20]

[iii] In general, children were presented with objects and verbal instructions and then their behavior was observed and recorded. The 11 of the 13 core items reflect tasks involving an object (i.e., a bell, ring, picture book, cubes, cup, box, little car, and pegboard), but two tasks did not involve objects (i.e., children's spontaneous vocalizations and response to a spoken request).

or younger (and therefore not generally eligible to have completed high school); and those older than age 18.

Household Income. Household income was measured using data provided in the ECLS-B baseline parent interview. We created a set of dummy variables with >$100,000/year as the reference category. The other categories are as follows: ≤$15,000; $15,001 to $30,000; $30,001 to $50,000; $50,001 to $75,000; and $75,001 to $100,000.

Marital Status. We created an indicator of the mother's marital status at the child's birth, where married mothers are the reference category and unmarried mothers are coded as 1.

Advanced Maternal Age. We created a dichotomous variable with a value equal to 1 for mothers aged 35 years or older at the time of the child's birth.

Race/Ethnicity. Race/ethnicity of the mother of the child is used to classify the child on the birth certificate, in accordance with National Center for Health Statistics procedures.[21] Non-Hispanic White is the reference category. The other categories are as follows: 1) African American; 2) Korean, Chinese, Indian, or Japanese; 3) Other Asian; and 4) Hispanic. Korean, Chinese, Indian, and Japanese infants were considered separately from other Asians because these children traditionally score higher on cognitive tests.[22]

Medical Risk Factors. We constructed a count of the medical risk factors present during pregnancy from the following list: incompetent cervix, acute or chronic lung disease, chronic hypertension, pregnancy-induced hypertension, eclampsia, diabetes, hemoglobinopathy, cardiac disease, anemia, renal disease, genital herpes, oligohydramnios, uterine bleeding, Rh sensitization, previous birth weighing 4000+ grams, or previous preterm birth.

Behavioral Risk Factors. We constructed a count of maternal behavioral risk factors occurring during pregnancy, as recorded on the birth certificate. Behavioral risks include any maternal use of alcohol and/or tobacco use during pregnancy.

Obstetric Procedures. We created a count of the following obstetric procedures occurring during pregnancy, labor and/or delivery: induction of labor, stimulation of labor, tocolysis, amniocentesis, and cesarean section.

Labor Complications: We constructed a count of the number of labor complications experienced from the following list: abruptio placenta, anesthetic complications, dysfunctional labor, breech/malpresentation, cephalopelvic disproportion, cord prolapse, fetal distress, excessive bleeding, fever of >100 degrees, moderate/heavy meconium, precipitous labor (<3 hours), prolonged labor (>20 hours), placenta previa, or seizures during labor.

Preterm Delivery. We constructed two indicators regarding preterm delivery. The first indicates very preterm births. This was equal to 1 for births occurring at ≤32 weeks completed gestation. The second indicates moderately preterm births. This was equal to 1 for birth occurring between 33 and 36 weeks completed gestation.

Birthweight. We constructed two indicators for the child's birthweight. Very low birthweight was a dichotomous variable equal to 1 for births weighing ≤1500 grams. Moderately low birthweight was a dichotomous variable equal to 1 for births weighing 1,501-2,500 grams.

Low APGAR. A dichotomous variable was coded 1 for infants with 5-minute APGAR scores below 7.

Congenital Anomaly. A dichotomous variable is set equal to 1 if any congenital anomaly was present at birth.

Analyses

We examined whether parents' socio-demographic characteristics (i.e., maternal education, household income, marital status, race/ethnicity, advanced age) are associated with low cognitive development, measured at both 9 months and 24 months of age. We then tested whether these associations are mediated by the measured gestational and birth-related risk factors. Because twin and higher-order multiple pregnancies are at increased risk for medical complications and early delivery,[23] we conducted separate analyses for singleton and non-singleton children. All models were conducted with logistic regression and incorporated sampling weights and design effects to appropriately account for ECLS-B's oversampling and stratified cluster design.

Results

Table 1 shows descriptive statistics for the samples of singleton and non-singleton births. The age and gender distributions of the two groups are similar. However, likely due to their greater use of fertility-enhancing drugs, college-educated, higher income, older (age >34), married, and White mothers are over-represented among the multiple births. Also not surprisingly, multiple births involved more medical risk factors, obstetric procedures, labor complications, and pre-term and low birthweight births. Multiple births also had slightly lower APGAR scores, and a slightly higher rate of congenital anomalies. At both 9 and 24 months, approximately 9.8 percent of singletons fell into the low cognitive functioning group. This is because singletons are the great majority of all births, and we defined low cognitive functioning as falling into the bottom 10 percent of scores. Among multiple births, 22.4 percent fell into the bottom 10 percent of scores at approximately 9 months of age, but only 15.5 percent were in the bottom 10 percent at approximately 24 months. Non-singletons, who are more likely to be preterm, have low birthweight, and experience other risk factors, also appear to make strong progress in overcoming the deleterious consequences of these factors as they age, at least from 9 to 24 months.

(Table 1 about here)

Table 2 displays results of logistic regression analyses predicting low cognitive functioning, separately at 9 and 24 months. For each time period we present two regression models. The first set of regressions uses only socio-demographic variables as predictors; the second adds gestational and birth characteristics to the models. The numbers shown are the effects of each predictor on the odds of a child falling into the low cognitive functioning group, after controlling the other variables in the equation.

(Table 2 about here)

We begin by examining the first and third columns of this table, showing the results using only exogenous socio-demographics as predictors at both 9 and 24 months of age. These "reduced-form" regressions show the total effects associated with these variables on predicting low cognitive functioning at 9 and 24 months.

The older the child was at testing, the lower their chance of falling into the low-functioning group. This effect was very strong and statistically significant at approximately 9 months of age, but much weaker and not significant at approximately 24 months. Males were more likely to fall into the low performing group, an effect that is strong and statistically significant only at 24 months of age. As with gender, maternal education significantly affects the odds of low cognitive performance only at 24 months. In particular, children of mothers aged 18 or older who dropped out of high school have a significantly increased risk of low cognitive performance relative to children of college-educated mothers. There is also evidence that children from lower-income households have higher odds of low cognitive performance. By 24 months of age, the effect is most strongly and significantly found among children in the lowest income groups.

With these variables controlled, whether or not the mother is 35 or older, and whether or not she is unmarried, do not exert significant effects. African-American, Other Asian, and Hispanic children show significant and strongly increased risks of low-functioning at 24, but not at 9 months.

The "expanded-form" regressions are displayed in columns 2 and 4. Here gestational and birth characteristics are added to the equations. When this is done, the socio-demographic effects change hardly at all. This demonstrates that the effects of socio-demographic characteristics do not operate via gestational and birth characteristics, but rather occur over and above any such causal mechanisms. (For example, they may be due to parenting differences across socio-demographic groups.)

A number of the gestational and birth characteristics show reasonably large effects at 9 months of age. The most powerful of these is very low birthweight, which increases a child's odds of low cognitive functioning at 9 months by a factor of 22.8! Next in size are very pre-term and moderately low birthweight, which increase a child's odds of low cognitive functioning by 4.4. Significantly increased 9-month odds are also observed for moderately pre-term births and those with congenital anomalies.

A number of these effects decline dramatically by 24 months of age. Most importantly, the odds for very low birthweight decline from 22.8 to 2.4. Those for very pre-term and moderately low birthweight also decline substantially, although they remain significant. The odds for moderately preterm and congenital anomalies are no longer significant. While being born very pre-term and at both very low and moderately low birthweight still involve an increased risk of low cognitive functioning at 24 months, it is evident that many children are able to recover from these biophysical risk factors as they age.

The findings in Table 2 may be summarized as follows. First, a range of socio-demographic variables elevate a child's risk of low cognitive functioning at 24 months, but not at 9 months of age. Noteworthy among these risk-factors are being male, having a high school dropout mother over the age of 18, having a low family income, and being African-American, Other Asian, or Hispanic. These effects are *not* in general attributable to the association between these socio-demographic characteristics and either gestational or birth characteristics.

Second, a number of gestational and birth characteristics increase a child's risk of low cognitive functioning. Noteworthy among these are being born very and moderately low birthweight, and very preterm. However, in general, the magnitudes of effect of these factors decline strongly as the infant ages from 9 to 24 months. By 24 months of age, the largest effects are for very pre-term and/or very low birthweight children. However, by this age, these effects are of similar magnitude to the independent risk factors associated with being male, having a high school dropout mother over the age of 18, being low income, and being African-American, Other Asian, or Hispanic.

Table 3 repeats these analyses for non-singleton births. Children who are also either very low birthweight, moderately low birthweight, and very or moderately preterm are particularly likely to display low cognitive functioning at 9 months, with odds of 14.5, 3.3, 3.9, and 4.1, respectively. However, remarkably and consistent with the results for singletons, these odds all decline substantially by 24 months, and lose statistical significance. (The loss of statistical significance is likely partly due to the smaller sample size for non-singletons.) Thus, as with singletons, between 9 and 24 months, non-singletons tend to recover remarkably strongly from the risks associated with a pre-term and low birthweight delivery.

Non-singletons also show the other two patterns observed for singletons – increased risk for males and for ethnic minority groups at 24 as compared with 9 months, and a failure of these risks to be accounted for by gestational- and birth-related risk factors. Among non-singletons, significant high risks are observed for males, low income, and African-American children. A difference between multiple births and singletons, however, is that multiple obstetric procedures are associated with significantly elevated risks at 24 months for non-singletons, but not singleton births. In sum, the results for non-singletons show generally similar patterns to those observed for singletons, with differences in magnitudes of effect and statistical significance due largely, but not entirely, to the greater fragility of children from multiple births, and the smaller sample size available to study them.

The results in Tables 2 and 3 are based on defining "low cognitive functioning" as falling into the bottom 10% of all student performance scores. To check on the robustness of these results to changes in this 10% cutoff value, we replicated these regressions using both 5% and 15% as cutoff values. In general, the odds reported change only by small amounts if at all, and the overall patterns of effects discussed above remain unchanged. However, a number of coefficients either gain or lose statistical significance at the .05 level (results available upon request).

Discussion

This study sought to identify the nature and patterning of risks—both biological and social--for cognitive delay among children during the first two years of life. Capitalizing on the availability of a new, nationally representative dataset containing both complete birth certificate information and standardized developmental assessments, we examined the effects of a range of socio-demographic and biophysical characteristics on the likelihood of low cognitive functioning. Consistent with previous research on smaller samples drawn from clinical settings,[24-26] we found that biophysical factors including shortened gestation, very low birthweight, and associated conditions (congenital anomalies) and indicators (low APGAR score) are strongly associated with elevated risk for low cognitive functioning.

In contrast to many previous studies, cognitive assessments were available at two time points during very young childhood, allowing for an examination of early risk trajectories. The effects of most gestational and birth characteristics, while still important, decline in magnitude over the interval between 9 and 24 months. Concomitantly, the influence of socio-demographic characteristics including maternal education, household income, and race/ethnicity increase, and become roughly equal in size to the effects of the gestation and birth-related factors by the time children reach 2 years of age.

Although rates of preterm birth and low birthweight are consistently elevated among socio-economically disadvantaged and non-white women,[27] it is important to note that the socio-demographic effects on risk of low cognitive functioning seen in our analyses were not attributable to an increased likelihood of experiencing these gestational and birth characteristics. Instead, the risks associated with a child's socio-demographic characteristics operated independently from those mechanisms. This finding underscores the importance of determining the processes through which socioeconomic disadvantage adversely affects development in very early childhood. Aspects of a child's physical health, such as iron deficiency and exposure to lead and other environmental toxins, are likely to play a role, as these conditions are differentially found in economically disadvantaged populations and are associated with cognitive delay. It is also plausible that other factors, such as parenting style and practices, differ across socio-demographic groups in ways that impact a child's cognitive development. The potential importance of parenting is highlighted in work by Smith and colleagues,[28] who examined the relationship between one aspect of parenting—maternal responsiveness—and cognitive development among very low birthweight and normal birthweight children. They found that children parented with higher levels of responsiveness showed generally higher levels of cognitive ability, and that higher risk birth status coupled with minimally responsive parenting resulted in significantly lower cognitive scores.

As rates of multiple births continue to rise,[27] cognitive outcomes among this potentially at-risk population are of considerable interest. We found that, as was the case among singletons, both gestational/birth characteristics and socio-demographic factors were associated with increased risk of low cognitive functioning at 9 months, with the strongest effects associated with gestation ≤32 weeks. By 24 months, socio-demographic factors become increasingly important, and younger maternal age, low household income, and African American, Hispanic, and Native American race/ethnicity are associated with greater odds of low cognitive functioning than those seen among singletons. Further research is needed to explore the mechanisms underlying the heightened risks for these subgroups.

In interpreting the findings from this study, it should be borne in mind that the analyses rely heavily upon information reported on birth certificates. Although widely used, these data may be subject to error, particularly with regard to complications of pregnancy and delivery.[29] Another consideration is that the outcome of interest, low cognitive functioning, may have been measured with more precision at 24 months than at 9 months, given that a wider range of behaviors can be observed as the child matures.

The study findings have important implications for pediatric practice. Most significantly, a pediatrician's assessment of risks for cognitive delay in early childhood should include not only well-recognized biological factors such as length of gestation and birthweight, but also multiple features of the child's social environment. While elevated odds of poor cognitive functioning at 9 months are most strongly associated with very low birthweight and being very preterm, by 24 months maternal education, household income, and other social factors are equally important in predicting cognitive delay. The change in risk patterns from 9 to 24 months suggests that early childhood is a crucial transition period for the promotion of cognitive growth. The recommended developmental assessment schedule during this period, which includes routine surveillance during well child visits and a standardized assessment at 9 and 18 months,[2] may be insufficient in socio-economically disadvantaged populations. Moreover, a recent survey of pediatricians indicates that only about one-fourth adhere to current screening guidelines.[30] While much remains to be learned about why social disadvantage translates into developmental delay even at the earliest ages, appropriate developmental screening and provision of high-quality supplementary services when indicated are likely to have an important positive impact on subsequent cognitive growth.

Table 1. Singleton and Non-Singleton Demographics, Gestational and Birth Factors, and Cognitive Test Scores[a], Early Childhood Longitudinal Study-Birth Cohort (ECLS-B)

	Singletons (n=3,896)			Non-Singletons (n=891)	
	Mean	SD		Mean	SD
Child Age, Round 1 (months)	9.6	0.7		9.7	0.7
Child Age, Round 2 (months)	24.3	1.2		24.2	0.9
Male	49.9%			48.2%	
Maternal education=college graduate	28%		**	36%	
Maternal education=some college	23%			25%	
Maternal education=high school graduate	31%			26%	
Maternal education<high school; age > 18	13%			12%	
Maternal education<high school; age ≤ 18	5%			2%	
Household Income ≤15K	16.6%			14.0%	
Household Income 15,001-30K	24.3%			17.8%	
Household Income 30,001-50K	21.8%			20.2%	
Household Income 50,001-75K	16.5%			18.4%	
Household Income 75,001-100K	10.6%			14.1%	
Household Income > 100K	10.1%		**	15.5%	
Maternal age=35 or older	14%			17%	
Marital status=unmarried	31%			25%	
White	69%		**	77%	
African American	16%			15%	
Korean, Chinese, Indian or Japanese	1%			<1%	
Other Asian	1%			<1%	
Hispanic	13%			8%	
Medical Risk Factor(s)	0.20	0.5	**	0.29	0.6
Behavior Risk Factor(s)	0.40	0.4		0.14	0.4
Obstetric procedures	0.62	0.7	**	0.85	0.6
Labor complications	0.36	0.6	**	0.66	0.7
Very Pre-term ≤ 32 weeks	2%		**	12%	
Moderately Pre-term 33 to 36 weeks	8%		**	43%	
Very low birthweight ≤ 1500 gm	1%		**	7%	
Moderately low birthweight 1501-2500 gm	5%		**	48%	
Low 5 Minute APGAR (< 7)	0.1%			1.9%	
Congenital Anomaly	5%			7%	
Age of Mother	27.4	6.4	**	28.7	6.0
Gestation (weeks)	39.0	3.9	**	35.5	3.2
Birth Weight (grams)	3358	772	**	2411	620
Five Minute APGAR Score	8.9	0.8		8.7	0.8
Bayley Mental Score, Round 1	73.0	4.8	**	69.5	4.5
Bayley Mental Score, Round 2	127.4	10.6	**	123.6	10.5
Low Cognitive Functioning, Round 1	9.7%		**	22.4%	
Low Cognitive Functioning, Round 2	9.8%		**	15.5%	

[a] Weighted estimates; see text for details
** - Significant at p=0.05.

Table 2. Odds Ratios from Multiple Logistic Regressions Modeling Low Cognitive Functioning[a] at Approximately 9 and 24 Months of Age, Singleton Children (n=3,896)

	9 Months		24 Months	
Child age (months)	0.2**	0.1**	0.9	0.9
Child sex=male	1.2	1.2	2.0**	2.0**
Maternal education=some college	0.8	0.7	1.3	1.3
Maternal education=high school graduate	1.1	1.0	1.4	1.4
Maternal education<high school; age > 18	1.4	1.1	1.9**	2.0**
Maternal education<high school; age ≤ 18	1.5	1.3	1.0	1.0
Household Income ≤15K	1.6	1.4	2.0**	2.0**
Household Income 15,001-30K	2.5**	2.3**	1.8	1.9**
Household Income 30,001-50K	2.3**	2.2	1.6	1.6
Household Income 50,001-75K	1.4	1.2	1.5	1.5
Household Income 75,001-100K	1.9	1.7	1.3	1.2
Maternal age=35 or older	1.0	0.9	1.2	1.1
Marital status=unmarried	0.9	0.8	1.0	1.0
African American	1.2	1.1	2.2**	2.0**
Korean, Chinese, Indian or Japanese	0.6	0.8	1.0	1.0
Other Asian	0.9	0.8	3.0**	2.7**
Hispanic	1.0	1.1	2.7**	2.5**
Medical Risk Factor(s)		1.4		0.9
Behavior Risk Factor(s)		1.4		0.7
Obstetric procedures		0.8**		0.9
Labor complications		0.9		0.8
Very Pre-term ≤ 32 weeks		4.2**		2.5**
Moderately Pre-term 33 to 36 weeks		2.6**		1.2
Very low birthweight ≤ 1500 gm		22.8**		2.4**
Moderately low birthweight 1501-2500 gm		4.4**		1.6**
Low 5 Minute APGAR (< 7)		2.0		1.6
Congenital Anomaly		1.7**		1.2

[a]Lowest 10% of Bayley Mental Score
** - Significant at p=0.05.

Table 3. Odds Ratios from Multiple Logistic Regressions Modeling Low Cognitive Functioning[a] at Approximately 9 and 24 Months of Age, Non-Singleton Children (n=891)

	9 Months		24 Months	
Child age (months)	0.4**	0.3**	1.0	0.9
Child sex=male	1.3	1.4	2.2**	2.2**
Maternal education=some college	0.9	1.5**	0.8	0.7
Maternal education=high school graduate	0.7	1.3	0.6	0.7
Maternal education<high school; age > 18	0.7	1.4	1.1	1.0
Maternal education<high school; age ≤ 18	1.5	3.6	1.5	1.7
Household Income ≤15K	1.2	0.9	2.7	2.1
Household Income 15,001-30K	1.0	0.8	2.7**	2.7**
Household Income 30,001-50K	2.0**	1.2	1.4	1.1
Household Income 50,001-75K	1.2	0.9	1.2	1.1
Household Income 75,001-100K	1.6	1.1	1.0	0.9
Maternal age=35 or older	1.3	1.3	1.6	1.8
Marital status=unmarried	2.1**	1.5	1.1	1.0
African American	1.0	0.7	3.0**	4.1**
Korean, Chinese, Indian or Japanese	1.2	0.4	0.0**	0.0**
Other Asian	0.4	0.3	0.4	0.5
Hispanic	0.7	0.5	1.4	1.9
Medical Risk Factor(s)		1.2		0.9
Behavior Risk Factor(s)		0.5		1.8
Obstetric procedures		0.7		1.6**
Labor complications		1.0		1.1
Very Pre-term ≤ 32 weeks		3.9**		2.4
Moderately Pre-term 33 to 36 weeks		4.1**		1.5
Very low birthweight ≤ 1500 gm		14.5**		1.7
Moderately low birthweight 1501-2500 gm		3.3**		1.2
Low 5 Minute APGAR (< 7)		0.4		0.8
Congenital Anomaly		0.9		1.5

[a]Lowest 10% of Bayley Mental Score
** - Significant at p=0.05.

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