Cumulative Social Risk Exposure, Infant Birth Weight, and Cognitive Delay in Infancy

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ABSTRACT

OBJECTIVE: To determine the effect of exposure to multiple social risks on cognitive delay at 9 months of age; and whether obstetric factors mediate the relationship between cumulative social risk and cognitive delay.

METHODS: Data were from 8950 mother–child dyads participating in the first wave of the Early Childhood Longitudinal Study, Birth Cohort. Cognitive delay was defined as falling in the lowest 10% of mental scale scores from the Bayley Short Form–Research Edition. Five social risk factors were combined and categorized into a social risk index. Staged multivariable logistic regressions were used to investigate whether obstetric factors mediated the impact of social risk on the odds of cognitive delay.

RESULTS: Infants with cognitive delay were more likely to live with social risks than infants without cognitive delay. The percentage of infants with cognitive delay increased with the number of social risks. In adjusted analyses, exposure to multiple social risk factors was associated with higher odds of cognitive delay at 9 months of age (adjusted odds ratio 2.11; 95% confidence interval 1.18–3.78 for 4 or more risks vs no risks). Accounting for birth weight attenuated this relationship ($P < .001$).

CONCLUSIONS: This population-based study investigated the independent and cumulative effects of social risk factors on cognitive delay in infancy. Findings revealed a significant cumulative relationship between exposure to social risk and cognitive delay, which was partly mediated by birth weight. Programs that address the social context of US infants are needed to improve their developmental trajectories.

KEYWORDS: birth weight; child development; infancy; life course; social environment

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WHAT'S NEW

National data show a significant cumulative relationship between exposure to social risks and cognitive delay in infancy, which is mediated by infant birth weight. Programs that address the social context of US infants are needed to improve their developmental trajectories.

SOCIAL RISK FACTORS including poverty,[1] single-parent families,[2] and low parental education[3] are consistently among the strongest correlates of poor cognitive and developmental outcomes among children. However, despite the well-established relationship between social risk factors and children's cognitive outcomes and academic achievement,[4–8] comparatively little work has investigated the relationship between social risk factors and cognitive delay in infancy. This represents a vital gap in the literature because infancy marks a critical period with significant implications for children's cognitive development. In fact, the prevalence of cognitive delay has been shown to be highly dynamic in early childhood, whereby a substantial proportion of infants with cognitive delays at 9 months of age display normal cognitive development by 24 months.[9] Nevertheless, for some children, early cognitive delays persist over time,[4] threatening their school readiness[10] and long-term health and functioning.[11] Improving our understanding of the relationship between social risk factors and cognitive delay during this critical stage in the life span may therefore have substantial impacts on prevention, treatment, and rehabilitation strategies.

The relationship between social risk factors and early cognitive outcomes may be best explored from the life course perspective, which conceptualizes child health as arising from cumulative effects of events and exposures at different life periods, as well as from intergenerational effects.[12–16] For example, social risk factors like race, poverty, and education are known to influence the risk of adverse obstetric outcomes,[17–21] and obstetric outcomes have been associated with cognitive delay at school age.[22–24] A linked pathway may therefore exist among

maternal social risk factors, adverse obstetric outcomes, and early child cognition; as such exposure to social risk factors increases women's risk of having poor obstetric outcomes and obstetric outcomes in turn contribute to early cognitive delay. A cumulative risk model would suggest that social risk factors influence early childhood cognition via an additive effect, in which there is an accumulation of risk caused by individual negative exposures.[16] However, although several studies have demonstrated that poor child health and developmental outcomes are accelerated by exposure to multiple risks relative to singular risk exposure,[25–29] it is unknown whether social risk factors influence cognition in infancy via the same cumulative mechanism.

We investigated the relationship among social risks, including family demographic and socioeconomic factors, and cognitive delay among infants participating in the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B). We examined the independent and cumulative effects of social risk factors on cognitive delay and explored whether these relationships were mediated by obstetric factors. We hypothesized that social risks would be associated with early cognitive delay in a cumulative manner, but that this risk would be partially attributable to social disparities in obstetric outcomes. To our knowledge, this is the first nationally representative life course study in the United States to examine the cumulative influence of social risk factors on cognitive delay in infancy.

METHODS

DATA SOURCE

Data were drawn from the first wave of the ECLS-B, a nationally representative, population-based cohort study of nearly 11,000 US children from birth through kindergarten. A detailed discussion of the ECLS-B's data collection procedures and methodology is available elsewhere.[23] Briefly, the ECLS-B selected a nationally representative probability sample of the approximately 4 million children born in 2001, with oversampling of children from minority groups, twins, and children born at low and very low birth weights, based on registered births from the National Center for Health Statistics vital statistics system.[30] Children born to mothers under the age of 15 and those who were adopted or died before 9 months of age were excluded from the sampling frame.[31] The first data collection wave occurred in 2001 when the children were approximately 9 months old.

Restricted data for this study were obtained by approval from the Institute for Education Sciences Data Security Office of the US Department of Education, National Center for Education Statistics (NCES). In accordance with NCES guidelines, all reported unweighted sample sizes are rounded to the nearest 50.[30] The University of Wisconsin–Madison Health Sciences institutional review board considered this study exempt from review.

Participants were eligible for the current study if the biological mother was the main survey respondent and if the infant participated in the cognitive assessment

(n = 10,000); we excluded 250 infants with missing birth certificate information. The ECLS-B data set included individual records for each child sampled as a twin; for these families, a random number generator was used to randomly select one child from each pair to remain in the sample, leaving 8950 participants.

MEASURES

COGNITIVE DELAY

Cognitive delay was determined using the mental scale of the Bayley Short Form–Research Edition (BSF-R).[30] The BSF-R comprised a subset of items from the revised Bayley Scales of Infant Development, a standardized screening instrument of developmental status designed for children ages birth to 42 months.[32] The NCES recorded age-normed mental scale scores for the BSF-R (mean 50, standard deviation 10); the age at administration for children who were born preterm was recorded as their chronological age minus the number of weeks preterm. We considered children falling within lowest 10th percentile of the age-normed BSF-R mental scale (ie, those in the lowest 10% of ability relative to other children of the same age in our sample) to have a cognitive delay, similar to previous research.[33–35] We also tested alternative specifications of cognitive delay using the 5th and 15th percentile of the BSF-R as cutoffs and found consistent results with those using the 10th percentile delineation.

SOCIAL RISK INDEX

We examined 5 social risks assessed during the 9-month interview: family income at or below 100% of the federal poverty level; maternal black (non-Hispanic) race; maternal education less than high school; single-parent household status; and 3 or more children other than the index child living in the household. These factors were selected on the basis of their individual relationships with child health in existing research.[36,37] Bivariate analyses revealed that each factor was significantly associated with cognitive delay (Table 1).

To address our hypothesis that these risks would be associated with cognitive delay in a cumulative manner, we generated a social risk index by giving infants 1 point for the presence of each social risk. This risk-index approach, developed by Sameroff et al,[38] has been used in numerous studies of children's social, behavioral, and health development.[25–29] Scores ranged from 0 to 5, with higher scores reflecting more social risk (Cronbach's $\alpha = 0.53$).

COVARIATES

Birth certificates provided obstetric factors: 1) birth weight in grams (<1500 g, very low; 1500 to 2499 g, low; 2500 to 3999 g, normal; ≥4000 g, high); 2) pregnancy complications (anemia, diabetes, (oligo)hydramnios, lung disease, hypertension during pregnancy, cardiac disease, eclampsia, hemoglobinopathy, incompetent cervix, Rh sensitization, uterine bleeding, renal disease, genital herpes, other medical risk factors); 3) labor and/or delivery complications (febrile, moderate/heavy meconium,