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Maternal Education Level Predicts Cognitive, Language, and Motor Outcome in Preterm Infants in the Second Year of Life

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Abstract

Objective—To evaluate the relative impact of maternal education level (MEL) on cognitive, language, and motor outcomes at 20 months' corrected age (CA) in preterm infants.

Study Design—A total of 177 preterm infants born between 2008 and 2010 were tested at 20 months' CA using the Bayley Scales of Infant and Toddler Development-III. Multiple regression analyses were done to determine the relative impact of MEL on cognitive, language, and motor scores.

Results—Infants born to mothers with high school MEL were 3.74 times more likely to have a subnormal motor index, while those born to mothers with some college and graduate school MEL had reduced odds (0.36 and 0.12, respectively) of having subnormal language index at 20 months. In linear regression, MEL was the strongest predictor of cognitive, language, and motor scores, and graduate school MEL was associated with increases in cognitive, motor, and language scores of 8.49, 8.23, and 15.74 points, respectively.

Conclusions—MEL is the most significant predictor of cognitive, language, and motor outcome at 20 months' CA in preterm infants. Further research is needed to evaluate if targeted interventions that focus on early childhood learning and parenting practices can ameliorate the impact of low MEL.

Keywords

maternal education; neurodevelopmental outcomes; prematurity; motor outcome

Background

Maternal education level (MEL) is known to have a significant impact on neurodevelopmental (ND) outcome in preterm infants, and some studies suggest that it may

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Conflict of Interest

The authors report no conflict of interest

be a more powerful predictor of ND outcome than gestational age (GA) at birth and neonatal morbidities incurred during the neonatal intensive care unit (NICU) hospitalization, including sepsis, intraventricular hemorrhage (IVH), and bronchopulmonary dysplasia (BPD).[1–5] Although recently published studies have demonstrated a beneficial impact of higher MEL on school-age outcomes, these studies have included preterm infants who were born prior to changes in perinatal management over the past decade and have focused exclusively on cognitive outcomes.[2–5] Advances in neonatal and obstetric care such as antenatal steroids, surfactant, and nutritional management have resulted not only in the improved survival of extremely preterm infants but also in a decrease in the incidence of morbidities known to impact neurodevelopment.[6–8] Furthermore, there is mounting evidence that greater provision of human milk (HM; milk from the infant's own mother, excluding donor human milk) in the NICU, most often seen in mothers with higher MEL, substantially improves childhood ND outcome in preterm infants and that lack of HM is an independent risk factor for cognitive impairment.[9–12] As such, it is unclear whether MEL plays as significant a role in ND outcome in the current era. Also, to our knowledge no study has examined the relative impact of MEL on motor and language outcomes in a recent cohort of U.S.-born preterm infants. Thus, we sought to address this gap in the research literature by examining the impact of MEL on cognitive as well as language and motor outcomes in preterm infants at 20 months' corrected age (CA).

Methods

Population and Maternal Education Data

This was a retrospective chart review of 215 preterm born between 2008 and 2010, hospitalized in the Rush University Medical Center (RUMC) Neonatal Intensive Care Unit who had complete ND assessments at 20 months' CA in the RUMC Neonatal High Risk Follow-up Clinic. During the study period, inclusion criteria to be seen in the RUMC clinic included birth weight (BW) ≤ 1,500 g and/or GA ≤ 29 weeks as well as any twin or higher-order multiple sibling who did not meet the above criteria. All infants seen in the clinic were eligible for the study except for those infants with major congenital malformations and/or genetic syndromes who were excluded from the analysis. Sixty percent of very low birth weight (VLBW; BW < 1,500 g) infants cared for in the Rush NICU during the study years completed 20-month ND assessments. Mothers for whom MEL was unavailable were not included in the study ($N = 38$), leaving a final N of 177. Maternal education data were collected from the chart or through a database of infants who were enrolled in a larger prospective study focused on the impact of HM dose and exposure on neonatal hospital outcomes (NIH NR010009). MEL was categorized by the following five subgroups: (1) less than high school (<HS), defined as having completed less than 12 years of education; (2) HS graduate (HS), defined as having completed 12 years of education and having obtained an HS diploma; (3) some college, defined as trade or vocational school or any college attended for less than 4 years or one that does not grant a bachelor's degree; (4) college graduate, defined as having received a bachelor's degree; and (5) graduate school, defined as any amount of professional school beyond a bachelor's degree.

Neonatal and Sociodemographic Risk Factors

Collected sociodemographic data included maternal age, race/ethnicity, type of medical insurance, and maternal occupation coded according to Hollingshead's criteria[13] with unemployment receiving a code of "0." Birth data included in-utero drug exposure, antenatal steroid administration, mode of and reason for delivery, infant BW and gestational age (GA), outborn status, multiple gestation, and small for gestational age status, defined as BW less than 10th percentile according to Fenton.[14] Neonatal morbidity information collected included patent ductus arteriosus treated with medication and/or surgery, treated hypotension, the presence of BPD, defined as oxygen dependence at 36 weeks' CA, sepsis, defined as a positive blood or cerebrospinal fluid culture at any point during the NICU hospitalization, necrotizing enterocolitis (NEC) stage 2 to 3, defined according to Bell criteria, spontaneous intestinal perforation (SIP), any stage of retinopathy of prematurity (ROP), and head ultrasound findings.[15] Severely abnormal head ultrasound (SAHUS) was defined as a grade 3 or 4 IVH, periventricular leukomalacia, or ventricular dilatation. Finally, at discharge from the NICU, data addressing home oxygen therapy, diet of HM, and CA were collected.

Neurodevelopmental Follow-Up Data

During the period of study, it was the policy to evaluate all infants with BW ≤ 1,500 g and/or GA ≤ 29 weeks as well as their twin or higher-order multiple siblings who may not have met the above criteria in the Neonatal High Risk Follow-up Clinic, a multidisciplinary clinic which monitors the growth, neurologic, and developmental status of infants cared for in the NICU. Infants were scheduled for routine visits at 4, 8, and 20 months' CA. The neurologic examination of muscle tone was performed at every visit according to Amiel-Tison and Stewart.[16] Approximately 75% of the neurologic exams were performed by one neonatologist, with the remaining exams being performed by another neonatologist who was trained in the assessment if the primary physician was unavailable. Neurologic abnormalities were classified as hypertonia, hypotonia, and cerebral palsy. At 8 and 20 months' CA, patients were routinely assessed by one of two pediatric ND psychologists with expertise in preterm infant assessment using the Bayley Scales of Infant and Toddler Development-III (BSITD-III).[17] The BSITD-III are among the most commonly used tools to assess development in children from 1 to 42 months of age and have been utilized extensively in studies on preterm infant ND outcome.[1,9,10] The BSITD-III consist of a cognitive, language, and motor index score (mean index score is 100 ± 15) and five subscale scores: cognitive, receptive language, expressive language, fine motor, and gross motor (mean subscale score, 10 ± 3).[17] Outcome measures for this study included results of the neurologic exam and BSITD-III index and subscale scores. All scores > 1 standard deviation below the mean (<85 for index scores and <7 for subscale scores) were classified as subnormal, while all scores > 2 standard deviations below the mean (<70 for index and <4 for subscale scores) were classified as severely abnormal.

Statistical Analyses

Impact of the five MEL on ND outcome was evaluated by analysis of variance (ANOVA) or chi-square in bivariate analyses. ANOVA and chi-square bivariate analyses also determined

which birth, neonatal, and sociodemographic variables were significantly related to MEL ($p < 0.05$). Hierarchical stepwise procedures were used for multiple linear and logistic regressions predicting the impact of MEL on cognitive, language, and motor index scores. Birth and neonatal morbidities significantly associated with MEL in bivariate analyses ($p < 0.05$) were entered in the first step. Sociodemographic variables associated with MEL in bivariate analyses ($p < 0.05$) along with MEL were entered in the second step. Within each step, covariates with $p < 0.25$ were retained in final models. MEL less than HS served as the reference groups for MEL in regression analysis. The study was approved by the institutional review board of RUMC.

Results

Sociodemographic Data and Neonatal Morbidities

Sociodemographic, birth, and neonatal data of the 177 infants (mean BW, 1,049 ± 307 g; mean GA, 28.3 ± 2.5 weeks) are presented in Table 1. The MEL breakdown for the mothers was as follows: less than HS ($n = 30$), HS graduate ($n = 36$), some college ($n = 58$), college graduate ($n = 32$), and any graduate school ($n = 21$). Mothers with higher MEL were significantly more likely to be older ($p < 0.0001$), of white race ($p < 0.0001$), have private health insurance ($p < 0.0001$), have occupations rated more prestigiously according to Hollingshead's coding system ($p < 0.001$), have more female infants ($p = 0.01$), more multiples ($p < 0.01$), and have higher rates of cesarean delivery ($p = 0.01$). Infants born to mothers with higher MEL also were significantly more likely to be on a diet of either exclusive or partial HM at discharge from the NICU ($p = 0.001$). Infants of mothers with lower MEL were significantly more likely to have had neonatal sepsis ($p < 0.041$). There were no significant differences in the rates of BPD, SAHUS, ROP, or NEC/SIP among the five subgroups.

The 38 infants (18%) who were excluded from the analysis due to incomplete MEL data were significantly more likely to have experienced intrauterine drug exposure ($p < 0.0001$), have public health insurance ($p = 0.046$), be of higher GA ($p = 0.03$), and have older mothers ($p = 0.048$) when compared with the 177 infants who were included in the study.

Unadjusted Analyses of Neurodevelopmental Outcome at 20 Months

The mean BSITD-III index and subscale scores for each of the MEL groups are presented in Table 2. At 20 months' CA, 12% ($n = 22$), 43% ($n = 76$), and 19% ($n = 33$) of children had a subnormal (index < 85) cognitive, language, and motor index, respectively. Another 4% ($n = 7$), 19% ($n = 33$), and 6% ($n = 11$) had severely abnormal (index < 70) cognitive, language, and motor index scores, respectively. In bivariate analyses, cognitive index scores were significantly higher for MELs of some college or higher as compared with HS graduates ($p = 0.001$). Language index scores also were significantly higher for MEL of some college or higher as compared with MELs of HS graduate or lower ($p < 0.0001$). Receptive language subscale scores were significantly higher for MEL of graduate school as compared with all other MELs ($p < 0.0001$), while expressive language scores were significantly higher for MEL of graduate school compared with MELs of HS graduate or lower ($p < 0.0001$). Motor index scores were significantly higher for MEL of graduate school as compared with HS

graduate ($p = 0.002$), with most of the effect mediated through significantly higher fine motor subscale scores ($p < 0.008$). Although there was a trend toward higher gross motor subscale scores for the higher MEL groups, this difference did not reach statistical significance ($p = 0.06$). There were no significant differences in the rates of hypotonia, hypertonia, or cerebral palsy among the MEL groups.

Multivariate Analyses of Neurodevelopmental Outcome at 20 Months

The results of logistic regression analyses are presented in Table 3. Given the significant bivariate associations with MEL, the following covariates were entered into initial regression models alongside MEL: infant gender, cesarean section (C-section) delivery, multiple birth, sepsis, diet of HM at the time of NICU discharge, type of medical insurance, maternal race/ethnicity, maternal age, and maternal occupation. GA at birth also was entered as a covariate given its association with ND outcome. As noted earlier (under the section Statistical Analyses), only covariates with p-values < 0.25 were retained in the final logistic regression models. In final regression models, children born to mothers of MEL of HS were 3.74 times more likely to have a motor index < 85 compared with children from all the other MEL groups. Children born to mothers with MEL of some college and graduate school had reduced odds (odds ratio, 0.36 and 0.12, respectively) of having language index < 85. Public health insurance and lower GA also significantly predicted subnormal motor index, while GA was the only factor associated with subnormal language index. The subnormal cognitive index regression model did not reach significance. Furthermore, MEL was not a significant predictor of cognitive, language, or motor index < 70.

Results of linear regression analyses are shown in Table 4. Consistent with logistic regression models, given significant bivariate associations with MEL, the following covariates were entered into initial regression models alongside MEL: infant gender, C-section delivery, multiple birth, sepsis, diet of HM at the time of NICU discharge, type of medical insurance, maternal race, maternal age, and maternal occupation. Again, GA at birth also was entered as a covariate given its association with ND outcome. Only covariates with p-values < 0.25 were retained in the final linear regression models. After controlling for relevant covariates, MEL, namely, of graduate school, was the strongest predictor of cognitive ($p = 0.04$), language ($p = 0.002$), and motor ($p = 0.016$) index scores (Table 4). In the regression model, MEL of some college also predicted language outcome at 20 months' CA ($p = 0.01$). MEL of graduate school was associated with an 8.49 and 8.23 point increase in the cognitive and motor index, respectively, at 20 months' CA. For language index, MEL of some college was associated with an 8.81 point increase, while MEL of graduate school was associated with a 15.74 point increase in scores at 20 months' CA. In the final regression models, there were no significant associations between other sociodemographic characteristics, such as maternal age, occupation, race, and health insurance status, and Bayley outcomes. For medical variables, lower GA negatively impacted both cognitive and language index scores, while male gender was associated with lower language scores at 20 months' CA.

Discussion

We have demonstrated that in a contemporary cohort of U.S.-born preterm infants, MEL was the strongest predictor of motor and language index scores in addition to cognitive index scores, and that higher MEL decreased the risk for subnormal language and motor scores at 20 months' CA. Furthermore, MEL was a stronger predictor of ND outcome than other socioeconomic factors such as maternal occupation, age, and health insurance status, which have been shown previously to impact neurodevelopment in U.S.-born extremely preterm infants.[18,19] Our findings are consistent with prior studies demonstrating a protective effect of high MEL on cognitive and language function in preterm infants.[1–5] However, our findings are among the first to reveal an association between MEL and motor outcome in this population.

Several studies conducted with preterm infants born in the 1980s and 1990s established significant relationships between MEL and ND outcome in childhood and young adulthood.[2,4,18] Vohr et al reported on U.S.-born extremely low birth weight (ELBW) outcomes and found that MEL less than HS and public health insurance, often used as a proxy for socioeconomic status in the United States, were significant predictors of both motor and cognitive impairment at 18 to 22 months' CA.[18] Although similar to our findings in that the investigators found an association between MEL and motor outcome at 2 years, the analysis was part of larger study examining center differences in outcome and did not specifically examine the impact of individual MELs on ND outcome.[18] Voss et al reported on a regional ELBW cohort from Germany and found that at 10 years children born to mothers with low MEL were almost 22 times as likely to have a decreased composite IQ as compared with children born to mothers with high MEL.[2] Furthermore, they noted that the impact of high MEL on ND trajectory was greatest for ELBW infants with IVH, underscoring the long-term potential for MEL to impact ND outcome, particularly in children with the highest risk for impairment. Finally, Weisglas-Kuperus et al demonstrated the impact of MEL on adult cognitive outcome and found that at age 19 years, former preterm infants in the Netherlands with highly educated parents had a mean IQ 14.2 points higher than those with parents of the lowest category of education.[4] Although the strengths of these earlier studies have been the rigorous long-term follow-up of regional cohorts, many of these infants were born prior to advancements in neonatal care and were from relatively homogenous populations in terms of socioeconomic status, ethnicity, and access to health care.[2,4]

Similarly, whereas recent studies of preterm infants have also found a positive impact of MEL on cognitive outcome, we could locate only one previous study that compared ND outcome for MEL subgroups in a preterm infant cohort born after 2000 and utilized the BSITD-III to measure language in addition to cognitive outcomes.[1,3,5] Ko et al reported that infants born to mothers with MEL of ≥ partial college had significantly higher cognitive scores at 18 to 24 months as compared with mothers of MEL <HS, and those born to mothers with MEL of ≥ college graduate had significantly higher language scores.[1] These findings are similar to ours in that there was a progressive increase in cognitive, and even more so for language, with increasing MEL group. However, our study included an additional MEL subgroup of graduate school, and infants born to mothers in this subgroup

had a mean language index score that was almost 16 points higher than that of the other groups combined. Finally, our findings reveal a strong association between MEL ≥ graduate school and motor index that was largely due to performance in fine motor tasks at 20 months. As the BSITD-III is able to separate motor scores into gross and fine motor subscales, it may be that we are able to now measure more accurately this finding, whereas earlier reports were only able to comment on composite motor indices.[17,18]

Although not the focus of this study, it is worthwhile to speculate about mechanisms by which MEL impacts these ND domains. It is likely that MEL has a multifactorial impact on neurocognitive outcomes, via both genetic and environmental factors that are difficult to disentangle from one another. However, there is strong evidence that post-NICU environmental exposures may contribute significantly to ND outcomes in this population. For example, Stiver et al reported a strong association between higher MEL and cerebellar volume at 2 years of age in infants who were born at <32 weeks' GA, despite the fact that these differences were not seen on magnetic resonance imaging done at term CA.[20] Thus, the findings of Stiver et al suggest that MEL may preferentially impact exposures that boost ND outcome after hospital discharge.[20] This speculation is further supported by the concept of scaffolding, for example, wherein parents provide children with the necessary support to accomplish tasks that might otherwise be beyond that child's ability.[21] Lowe et al found that MEL was associated with more complex scaffolding specifically for preterm children, as compared with those born at term and that mothers of the sickest preterm infants who were of high MEL used the most complex scaffolding during play.[21] The authors suggest that the greater awareness on these mothers' part of their infants' risk resulted in efforts to compensate through their verbal communications and actions. We speculate that in our cohort differences in mother–child interaction through play and language could impact not only cognitive and language domains, but also fine motor skills. If so, it would be important to develop intervention programs targeted toward low MEL mothers in the NICU and after hospital discharge to facilitate these early learning experiences.

Our study has several strengths, including the fact that detailed MEL data were available for a majority of infants, this was a very recent cohort of preterm infants from the United States, and the fact that we assessed motor outcome in addition to cognitive and language outcome. Although a limitation of our study is that it is from a single center, the population is of racial/ethnic (41% African American and 28% Latino) and socioeconomic diversity (63% with public health insurance) and therefore may be more reflective of other NICUs in the United States. Another limitation is the loss to follow-up that 18% of the original cohort was excluded due to lack of information about MEL. Infants who did not attend the 20-month visit had slightly younger mothers and lower rates of BPD as compared with those who did complete the visit. The infants excluded for lack of MEL information had higher rates of intrauterine drug exposure and public health insurance and were of higher GA compared with the study infants. Excluded infants also had lower mean motor and language index scores at 8 months' CA, but mean BSITD-III scores were similar between the two groups at 20 months' CA. Finally, we acknowledge that there were significant differences between the MEL groups in terms of race, health insurance status, and infant gender, which are known to impact ND outcome. Nevertheless, MEL remained the strongest predictor of cognitive, language, and motor outcome even after controlling for these differences.

Conclusion

We have found that in a recent preterm infant cohort, MEL is the strongest predictor of ND outcomes at 20 months' CA, more so than any neonatal morbidity or other sociodemographic factors such as maternal occupation, and impacts motor and language outcome in addition to cognitive function. Additional research is needed to determine the impact of genetic and environmental factors on ND outcome and to see if targeted interventions that focus on parent education and early childhood learning experiences can ameliorate the impact of low MEL on former preterm infants.

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Table 1

Sociodemographic and birth data according to MEL groups

	<HS (*N* = 30)	HS graduate (*N* = 36)	Any college (*N* = 58)	College (*N* = 32)	Graduate school (*N* = 21)	*p*-Value
GA (wk)	28.2 ± 2.7	27.8 ± 2.3	28.2 ± 2.4	29.4 ± 2.3	28.4 ± 3	0.11
BW (g)	1,032 ± 292	1,000 ± 300	1,032 ± 281	1,162 ± 323	1,028 ± 369	0.23
Male gender	12 (40)	24 (67)	35 (60)	16 (50)	5 (24)	0.01
Race						
White	0 (0)	12 (33)	13 (22)	14 (44)	14 (67)	<0.0001
Black	7 (23)	13 (36)	35 (60)	13 (41)	5 (24)	
Hispanic	23 (77)	11 (31)	10 (17)	4 (13)	2 (10)	
Multiple	4 (13)	11 (31)	10 (17)	11 (34)	12 (57)	0.003
Small for gestation	4 (13)	3 (8)	11 (19)	6 (19)	4 (19)	0.65
Antenatal steroids	23 (77)	33 (92)	55 (95)	29 (91)	17 (81)	0.085
C-section delivery	19 (63)	17 (47)	41 (71)	26 (81)	18 (86)	0.01
Maternal age (y)	25.3 ± 8.3	26.8 ± 6.4	27.1 ± 6.2	31.7 ± 4.9	32.5 ± 4.9	<0.0001
Maternal occupational score[a]	1.15 ± 2.24	2.85 ± 3.35	3.06 ± 3.43	4.86 ± 3.47	7.00 ± 2.03	<0.0001
Public insurance	28 (93)	28 (78)	43 (74)	11 (34)	2 (10)	<0.0001
SAHUS[b]	1 (3)	7 (19)	4 (7)	1 (3)	3 (14)	0.081
BPD	11 (37)	16 (44)	26 (45)	10 (31)	9 (43)	0.70
Sepsis	7 (23)	9 (25)	8 (14)	1 (3)	1 (5)	0.041
ROP	8 (27)	9 (25)	8 (14)	3 (9)	4 (19)	0.27
NEC/SIP	5 (17)	6 (17)	6 (10)	0 (0)	2 (10)	0.18
Postnatal steroids	10 (33)	12 (33)	15 (26)	7 (21)	7 (33)	0.76
HM at discharge[c]	14 (47)	13 (36)	24 (42)	17 (53)	19 (91)	0.001

Abbreviations: BPD, bronchopulmonary dysplasia; BW, birth weight; GA, gestational age; HM, human milk; HS, high school; NEC, necrotizing enterocolitis; ROP, retinopathy of prematurity; SAHUS, severely abnormal head ultrasound; SIP, spontaneous intestinal perforation.

Note: Values are given as *N* (%) or mean ± standard deviation.

[a] Range 0 to 9, with higher scores denoting higher occupational status.[13]

[b] SAHUS defined as a grade 3 or 4 intraventricular hemorrhage, periventricular leukomalacia, or ventricular dilatation.

[c] Diet of any amount of human milk at the time of NICU discharge.

Table 2

Results of the BSITD-III and neurologic exam at 20 months

	<HS (*N* = 30)	HS graduate (*N* = 36)	Any college (*N* = 58)	College (*N* = 32)	Graduate school (*N* = 21)	*p*-Value
Bayley-III outcome						
Cognitive index	92 ± 12	88 ± 14	96 ± 12	98 ± 13	102 ± 12	0.001
Language index	78 ± 13	76 ± 17	87 ± 17	87 ± 14	99 ± 12	<0.001
Receptive	6.1 ± 1.8	5.8 ± 2.6	7.5 ± 2.6	7.4 ± 1.8	9.9 ± 2	<0.001
Expressive	6.4 ± 3	6.2 ± 3.3	8 ± 3.3	8.3 ± 3.3	9.9 ± 2.4	<0.001
Motor index	91 ± 12	86 ± 16	92 ± 10	93 ± 10	98 ± 7	0.004
Fine	9.9 ± 2.7	8.3 ± 3.1	9.5 ± 2.6	10 ± 2.5	10.8 ± 1.1	0.01
Gross	7.1 ± 2	7.2 ± 2.3	7.9 ± 1.8	7.5 ± 1.6	8.3 ± 1.3	0.062
Neurologic exam						
Cerebral palsy	1 (3%)	2 (6%)	1 (2%)	1 (3%)	0 (0%)	0.83
Hypertonia	5 (17%)	4 (11%)	6 (10%)	6 (19%)	3 (14%)	
Hypotonia	1 (3%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	

Abbreviation: HS, high school.

Table 3

Predictors of Bayley index scores < 85 at 20 months' corrected age

	Cognitive index < 85 (*N* = 22)	**Language index < 85 (*N* = 76)**	**Motor index < 85 (*N* = 33)**
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**
Birth and neonatal morbidities			
Gestational age	–	0.85 (0.76–0.98)[a]	0.82 (0.69–0.99)[a]
Male gender	–	1.60 (0.79–3.22)	–
Multiple	–	–	0.50 (0.19–1.32)
Sepsis	–	–	–
HM at discharge	0.46 (0.18–1.22)	–	–
C-section	–	–	0.44 (0.16–1.18)
Maternal sociodemographic variables			
Public insurance	2.27 (0.61–8.48)	2.24 (0.96–5.23)	3.45 (1.01–12.40)[a]
High school	2.0 (0.53–6.83)	0.91 (0.31–2.67)	3.74 (1.08–12.68)[a]
Some college	0.74 (0.14–3.85)	0.36 (0.143–0.96)[a]	0.84 (0.25–2.79)
College	0.35 (0.03–4.2)	0.61 (0.19–1.96)	0.69 (0.13–3.62)
Graduate school	0.00 (0.00–0.00)	0.12 (0.02–0.72)[a]	0.36 (0.03–4.35)
Total model	$X(5,6) = 10.02$ $R^2 = 0.11$	$X(5,7) = 31.70$[c] $R^2 = 0.23$	$X(5,8) = 28.45$[b] $R^2 = 0.15$

Abbreviations: CI, confidence interval; HM, human milk; OR, odds ratio.

Note: "–" denotes that the corresponding covariate's *p*-value was >0.25 and the covariate was therefore not retained in the final model.

[a] $p < 0.05$;

[b] $p < 0.01$;

[c] $p < 0.001$.

Table 4

Predictors of Bayley index scores at 20 months' corrected age

	Cognitive index	Language index	Motor index
	β	*β*	*β*
Birth and neonatal morbidities			
Gestational age	0.17[a]	0.15[a]	0.11
Male gender	–	−0.16[a]	–
Multiple	–	–	−0.15
Maternal sociodemographic variables			
Maternal age	−0.11	–	–
Public insurance	−0.11	−0.15	–
High school	−0.11	−0.02	−0.16
Some college	0.14	0.25[a]	0.06
College	0.14	0.13	0.08
Graduate school	0.21[a]	0.31[b]	0.23[a]
Total model	$F = 3.80$[b] $R^2 = 0.14$	$F = 7.2$[c] $R^2 = 0.23$	$F = 3.79$[b] $R^2 = 0.12$

Note: "–" denotes that the corresponding covariate's *p*-value was >0.25 and the covariate was therefore not retained in the final model.

[a] $p < 0.05$;

[b] $p < 0.01$;

[c] $p < 0.001$.