HHS Public Access

Author manuscript

Am J Perinatol. Author manuscript; available in PMC 2021 August 05.

Published in final edited form as:

Am J Perinatol. 2021 August ; 38(10): 1088–1095. doi:10.1055/s-0040-1702937.

Gestational age at birth and risk of developmental delay: The Upstate KIDS Study

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Abstract

Objective—To model the association between gestational age at birth and early child development through 3 years of age.

Study Design—Development of 5868 children in Upstate KIDS (New York State; 2008–2014) was assessed at 7 time-points using the Ages and Stages Questionnaire (ASQ). The ASQ was implemented using gestational age corrected dates of birth at 4, 8, 12, 18, 24, 30, and 36 months. Whether children were eligible for developmental services from the Early Intervention Program (EIP) was determined through linkage. Gestational age was based on vital records. Statistical

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Disclosure: The authors report no conflict of interest.

models adjusted for covariates including sociodemographic factors, maternal smoking and plurality.

Results—Compared to gestational age of 39 weeks, adjusted odds ratios (aOR) and 95% confidence intervals of failing the ASQ for children delivered at <32, 32–34, 35–36, 37, 38, and 40 weeks gestational age were: 5.32 (3.42, 8.28), 2.43 (1.60, 3.69), 1.38 (1.00, 1.90), 1.37 (0.98, 1.90), 1.29 (0.99, 1.67), 0.73 (0.55, 0.96), and 0.51 (0.32, 0.82). Similar risks of being eligible for EIP services were observed (aOR: 4.19, 2.10, 1.29, 1.20, 1.01, 1.00 (ref), 0.92, 0.78, respectively for <32, 32–34, 37, 38, 39 (ref), 40, 41 weeks).

Conclusion—Gestational age was inversely associated with developmental delays for all gestational ages. Evidence from our study is potentially informative for low-risk deliveries at 39 weeks but it is notable that deliveries at 40 weeks exhibited further lower risk.

Keywords

gestational age; developmental delay; preterm; early term

Introduction

Previous studies have found that earlier birth is associated with development in a dose-response manner, where lower gestational age is associated with a higher risk of developmental delay.[1–6] However, few studies have modeled developmental trajectories across the full span of viable gestational ages[4–6] and instead have focused on extremely preterm birth (<32 weeks). Given the high incidence of late preterm (34 to 36 weeks) and early term births (37 to 38 weeks gestation) in the United States, 7% and 26%[7], respectively, and the potential impact on early childhood development, it is important to model the effects of gestational age at birth across a continuum.

There have been numerous studies indicating that preterm birth before 37 weeks is associated with increased risk of developmental impairments compared to infants born at term.[2, 8–17] In general, birth between 34 and 36 weeks of gestation may be a risk factor for impairments in academic achievement or behavior in school-age assessments, but evidence is not as strong as those observed in earlier preterm births (<34 weeks).[18, 19]

There is less evidence concerning the risk of developmental delays for infants born early term at 37 to 38 weeks' gestation. Some studies report that developmental delays are only apparent for those born preterm, with effects not observed for early term births.[20, 21] However, other studies have found that birth at 37 to 38 weeks is associated with an increased risk of cognitive and physical impairments compared to later delivery, due to incomplete brain maturation in utero.[22–24] Information on long term outcomes for delivery at 40 and 41 weeks is sparse although limited data suggests risk for poor school achievement measured by literacy and numeracy at age 8 may be lowest for delivery at these later gestational ages.[25] This data gap is important given that the American College of Obstetricians and Gynecologists recently released a clinical Practice Advisory supporting offering routine elective of induction of labor at 39 weeks to women based on results from the ARRIVE trial[26] that found no statistical difference in the primary *short term* composite outcome of perinatal mortality and severe perinatal morbidity for women who were electively induced at 39 weeks versus expectantly managed.[27]

The purpose of this study was to assess the relationship between gestational age at birth across a continuum and early childhood development, obtained through parental report of the Ages and Stages Questionnaire (ASQ) at ages 4 to 36 months and using information on eligibility for developmental services through data linkage with New York State Early Intervention Program (EIP). We hypothesized that gestational age at birth would be inversely associated with risk of failing the ASQ and with eligibility for developmental services.

Methods

Study Design and Population

Upstate KIDS included children born in New York State (except New York City) from 2008 to 2010. The study was designed to examine how infertility treatments could impact child development and growth.[28] Thus, it oversampled on children conceived by treatment through enrolling singletons at 1:3 ratio for treatment versus no treatment.[28] All multiples were recruited regardless of mode of conception. We previously found no associations between infertility treatment and failing the ASQ after accounting for plurality.[29] 5,034 mothers of 6171 newborns enrolled at ~4 months postpartum. In this analysis, higher order multiples were excluded from analysis due to small numbers (n=134 children from 45 families). Children with at least one ASQ score were included in ASQ analyses, leaving 5,868 children of 4,853 mothers in our analysis, consisting of 3,772 singletons and 1,048 twin pairs. EIP analyses consisted of all children (n=6034 from 4989 families). The New York State Department of Health and the State University of New York at Albany Institutional Review Boards (NYSDOH #07–097; UAlbany #08–179) approved the study as designated by the National Institutes of Health under a reliance agreement. All parents provided written informed consent prior to data collection.

Child Development: The Ages and Stages Questionnaire

Mothers returned a questionnaire about their children’s health at 4–6, 8, 12, 18, 24, 30, and 36 months of age. Each questionnaire included the ASQ, a validated screening instrument designed to detect developmental impairments.[30–32] The ASQ evaluates five developmental domains: fine motor, gross motor, communication, personal-social functioning, and problem solving skills. For ages 4 to 12 months, the 2nd edition of the ASQ was utilized after which the 3rd edition was used. It was required that ASQs be completed within the specified age window to be valid. These windows adjusted for gestational age at delivery by use of corrected dates of birth to determine the child’s assessment age. Questionnaires were scored as “yes” = 10 points, “sometimes” = 5 points, and “not yet” = 0 points. Failure of a given domain of the ASQ is defined by a score that is two or more standard deviations below the United States national average for that development area and the specified age group.[32] If a child was reported to have failed a section of the ASQ, a follow-up was scheduled with the parents and trained staff to re-administer the failed ASQ domain. Final “failure” of an ASQ section was recorded for the initial screen date if (1) the child failed the follow-up ASQ administration or if (2) no follow-up appointment was administered.[28] Any indications of failure on the ASQ or developmental delays were referred to the EIP for additional evaluation as deemed appropriate.

Child Development: Linkage to Early Intervention

To further assess the presence of developmental delays, we linked the Upstate KIDS cohort to the EIP database. We first used exact matches on birth date and then scored matches based on matching with other identifiers (i.e., names and addresses). The record from EIP with the highest total score was considered a match. A child was considered an EIP risk if they were found eligible after testing. The risk group includes children who utilized EIP services as well as children who did not (due to their choice to use alternative/private services). All analyses for EIP results were conducted at the New York State Department of Health (NYSDOH) to preserve confidentiality of information.

Gestational Age at Birth and Covariates

Gestational age of the child was obtained from birth certificates,[33] which is a clinical estimate of gestational age using all perinatal factors available, including ultrasound and the number of full weeks from the mother’s last menstrual period (LMP).[33] Birth certificate information also included maternal age, child sex, plurality, and birth weight. Mothers reported at baseline their race/ethnicity, education, insurance, parity, smoking history, marital status, alcohol consumption during pregnancy, history of infertility treatment, history of hypertension, history of gestational diabetes, length and type of prenatal care, fish oil use, pre-pregnancy BMI, and the father’s BMI.

Statistical Methods

Chi-squared and t-tests were used to compare sociodemographic characteristics with respect to gestational age and plurality. Sociodemographic characteristics are displayed for all singletons and a randomly selected twin from each twin pair.

We used generalized linear mixed models with a logit link to estimate odds ratios (OR) and 95% confidence intervals (CI) for the association between gestational age at birth and ASQ failures. We used maternal-level and nested child-level random intercepts to account for repeated measures of children and the clustering of children within mothers.[28, 29] Non-linear trajectories of failing the ASQ were thus modelled by categorical time variable for the 7 time points. Thus, the longitudinal model accounted for variation in developmental stages and failures over the course of follow-up, remaining flexible to failing at each time point. These analyses used data from 17,661 screens provided during the 3 years of follow-up. There were 635 children with ASQs provided from all 7 time points. For graphical purposes, we plotted resulting unadjusted predicted probabilities of failing the ASQ over the gestational age continuum, and testing for interaction by infant sex and by plurality.

In subsequent analyses, we divided gestational age into eight levels to evaluate nonlinear associations: ≥ 41 weeks, 40 weeks, 39 weeks (reference group), 38 weeks, 37 weeks, 35 – 36 weeks, 32 – 34 weeks, and < 32 weeks. To determine if children born early term differ in risk of developmental delays compared to term children, we ran additional analyses combining early term children into a single category (37 to 38 weeks) and compared them with children born between 39 and 40 weeks as the reference group.

We first adjusted for maternal age, child sex, maternal education, maternal race, smoking during pregnancy, any alcohol during pregnancy, maternal BMI, and plurality. Additional models also adjusted for marital status, infertility treatment, prenatal fish oil supplement use, paternal BMI, size for gestational age, mode of delivery, and parity. Missing data for these latter covariates amounted to about 12% of the sample being dropped in using complete case analysis.

The risk of being eligible for the EIP (which indicated a documented delay in skills after developmental testing) was estimated using logistic regression with generalized estimating equation to account for correlation between twins. Odds ratios were adjusted for the same covariates as above. Analyses were conducted using SAS (v. 9.4) and R (v. 3.5).

Results

Table 1 displays participant characteristics with respect to preterm status and plurality. The preterm birth rate was 15% for singletons and 74% for twins. Differences between preterm versus term birth included lower birth weight and greater frequency of NICU admission. Other associations with preterm delivery included older maternal age, a decreased likelihood of alcohol consumption during pregnancy or to have 1st trimester prenatal care, higher use of infertility treatments, history of chronic conditions, and formula feeding of their newborns. Fathers of preterm children typically had a higher BMI and were older than fathers of term children.

Failure for any domain of the ASQ ranged between 6 and 10 percent at each screening time. Failure for specific domains were 1 to 5 percent. Figure 1 displays the association between the full range of gestational ages and probability of failing any developmental domain of the ASQ. Gestational age was inversely related to the probability of failing any developmental domain of the ASQ in Figures 1A and 1B, regardless of sex and plurality. Interactions were not significant and thus subsequent models were adjusted for but not stratified by sex or plurality.

Adjusted associations between higher gestational age at birth and ASQ failures (any failure and domain failures) are shown in Table 2. For each additional week in gestational age at birth, the adjusted odds ratio (aOR) of failing any developmental domain of the ASQ decreased (aOR 0.85, 95% CI: 0.82, 0.88). Adjusted odds ratios for the domain specific fails ranged from 0.79 to 0.87 per additional week of gestational age. Additional adjustment for fish oil and paternal BMI did not produce meaningful differences in estimates (data not shown). When we further examined associations while restricting the sample to nulliparous women, results were also virtually identical (data not shown).

To evaluate non-linear associations, gestational age was divided into eight categories. Table 3 shows the adjusted odds ratios of ASQ failures for the gestational age groups. Compared to 39 weeks of gestation, children born at less than 32 weeks and 32–34 weeks gestation were at a 5.32- fold and 2.43-fold higher risk of failing any domain. For the specific ASQ domains, every domain was associated with higher odds of fail for delivery at < 32 weeks' gestation and all, but the personal-social domain was associated with higher odds of fail at 32–34 weeks gestation compared to 39 weeks. At 35–36 weeks, children remained at higher risk of failing most domains (except personal-social and problem solving) compared to children delivered at 39 weeks. At 37 weeks, the gross motor and communication domains remained at higher odds of failing compared to 39 weeks and at 38 weeks communication fails remained significantly higher. Lower risk of ASQ failure was also observed for the 40 week group in the personal-social domain (OR = 0.65, 95% CI = 0.43, 0.98) and the 41 week or greater group in the fine motor domain (OR = 0.38, 95% CI = 0.16, 0.89) when compared to children born at 39 weeks.

In separate analyses, children born early term (37 – 38 weeks) were at higher risk of ASQ failure compared to children born between 39 and 40 weeks' gestation (OR = 1.49, 95% CI = 1.19, 1.85). This higher risk of failing the ASQ in early term infants was driven by failures in the gross motor and communication domains of the ASQ (OR = 1.64, 95% CI = 1.11, 2.42 and OR = 1.82 95% CI = 1.36, 2.43, respectively), whereas there were no significant differences with other domains (data not shown).

The associations between gestational age and being eligible for EIP services were evaluated (Table 4). There was a clear gradient of the association given the 39 week of gestational age in which earlier gestational age were clearly associated with increased risk of eligibility for EIP services. In the adjusted model, children born before 35 weeks were at a higher risk of EIP eligibility compared to children born at 39 weeks (32–34: aOR=2.10; 1.42–3.09; <32: aOR=4.19; 2.80–6.25). Similar trends for children born at 37 weeks having a higher risk of EIP were observed (aOR = 1.20, 95% CI = 0.89, 1.63). Risk of EIP eligibility for infants born at 38 weeks was not different from the reference group. However, children born at 40 or 41 or more weeks had a lower EIP risk when compared to infants born at 39 weeks gestation although the estimates were imprecise.

Discussion

Increasing gestational age at birth was associated with decreased risk for failing the ASQ and being eligible for early intervention, with children delivered at 40 weeks or even slightly post-term faring better when compared to children born at 39 weeks in a few developmental domains. Although very early preterm (less than 32 weeks) had the strongest and most consistent associations across developmental domains, risks remained elevated for children born at 32–36 weeks gestation. Children born early term at 37 and 38 weeks were at risk of failing the gross motor and communication domains of the ASQ

Our findings are generally consistent with previous studies that have found evidence for a graded association between gestational age and developmental delays.[2, 4–6] and specifically studies using the ASQ as an outcome measure also found an inverse dose-response association between gestational age at birth and assessment failures.[2, 6] In studies assessing outcomes at school age, earlier gestational age up to 36 weeks was associated with a decreased likelihood of kindergarten readiness by age 6 and decreased standardized test scores.[5] The Generation R Study also modeled an inverse association between gestational age at birth and risk of neuromotor development as measured by Touwen's Neurodevelopmental Examination.[4] In linear regression models, each additional week of gestational age was associated with a decrease in odds of non-optimal neuromotor development of 0.77 (95% CI: 0.71, 0.83)[4], but these effects did not remain significant after adjustment for post-conceptional age. In our models, we accounted for this by using gestational age corrected dates of birth to apply the screening test.[4] Given the mixed evidence probably due to the variability in the methods and timing of developmental assessments, more research is warranted to model early childhood development for the full continuum of gestational ages at delivery.

Our findings of developmental delays associated with early term birth (i.e. between 37 and 38 weeks gestation) were also supported by several studies.[17, 23] A 2016 population-based Australian cohort study (N = 153,730) found that planned birth at 37 or 38 weeks was independently associated with poor child development in the gross and fine motor skill assessment domains when compared to children born at 40 weeks.[23] Developmental speech and language delays have also been reported in early term children.[17] Taken together, these results suggest that birth between 37 and 38 weeks of gestation may put children at an increased risk of developmental delay. Interestingly, a study using Danish registries tracked the socioeconomic achievements of over 220,000 young adults and found educational attainment to be related to gestational age even in the term range.[34] Although the differences were small, they found that compared to 40 weeks of gestation, individuals born at 37 and 38 weeks were less likely to achieve tertiary education (aOR 0.80 [0.75, 0.86]; 0.85 [0.81, 0.89]) and belong to the highest tertile of income bracket (0.92 [087, 0.98]; 0.95 [0.91, 0.99]).[34] Hence, early differences in development even within the 37–38 weeks gestation range may have long-term implications.

Gestational age may have an impact on development through impaired brain growth[35], though the underlying etiology for the preterm delivery might also contribute. It has been shown that full-term brain weight increases approximately linearly with gestational age.[36] An earlier than expected exposure to the external environment may be detrimental to brain development through decreased neuronal connectivity and impaired formation of synapses in infants.[2] Given that such a large amount of brain development must occur outside of the womb at early gestational ages, these effects may be especially acute. Thus, the delay of these maturation processes may manifest in developmental delay.

This study also found a decreased risk of ASQ failure for children born at 40 weeks or later, specifically in the personal-social and fine-motor domains of the ASQ. These results further illustrate the importance of modeling gestational age on a continuum and have implications for standard induction practices. While there are risks for the fetus after a certain gestational age, these results suggest that there may also be potential developmental benefits to later induction. Further research is needed to account for competing risks.

The current findings are strengthened by the wide range of gestational ages present in the cohort, which enable us to examine early childhood development for the full continuum of gestational ages at delivery. We utilized the multiple measurements of child development between ages 4 and 36 months from a population-based birth cohort in the US, though this sample had a higher proportion of white, married, college-educated, and privately insured mothers than the US general population.[37, 38] We also accounted for a range of confounding factors and include data from both twins and singletons.

Although birth records are based on all available data to determine gestational age, estimates may display some variability due to discrepancies in ultrasound and LMP dating.[39] Additional limitations included attrition and missing ASQ assessments.[40] We accounted for this missing data using generalized linear mixed-models, robust to attrition.[41] It should be noted that the ASQ is not a diagnostic measure for impaired child development, but intended to screen for developmental delays that are often associated with intellectual disabilities.[30, 31] Studies have highlighted its limitations as a screening instrument,[42–44] particularly that it has high specificity which is useful in a general population to protect from false positive results but at the risk of low sensitivity and missing children with delays. However, we confirmed our findings using data linked to EIP based on whether children were eligible for services, which indicates failing diagnostic testing conducted by EIP. We lacked information on the timing or type of diagnostic tests failed prior to use of EIP services.

Conclusions

Gestational age was associated with early child development through age 3 years. Particularly important is the observation that children born early term (between 37 and 38 weeks) were also at an increased risk of failing the gross motor and communication domains of the ASQ. Moreover, risks continue to lower at 40–41 weeks. The elevated risks of developmental delay in our study provide further evidence that non-medically indicated early term births should be avoided if possible.[45] Our findings suggest that recent recommendations on timing of delivery[27] should be evaluated against evidence of long-term outcomes in children before implementing on a population level.

Acknowledgments

The authors would like to thank all the Upstate KIDS participants and staff for their important contributions. Thanks also to Drs. Kirsten Siegenthaler, Yan Wu, and Brian Fisher with the EIP data analysis at NYSDOH.

Funding Source: Supported by the Intramural Research Program of the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD; contracts #HHSN275201200005C, #HHSN267200700019C). NICHD approved the manuscript for publication but played no role in the study design, data collection, data analysis or interpretation, writing of the manuscript, or the decision to submit the article for publication.

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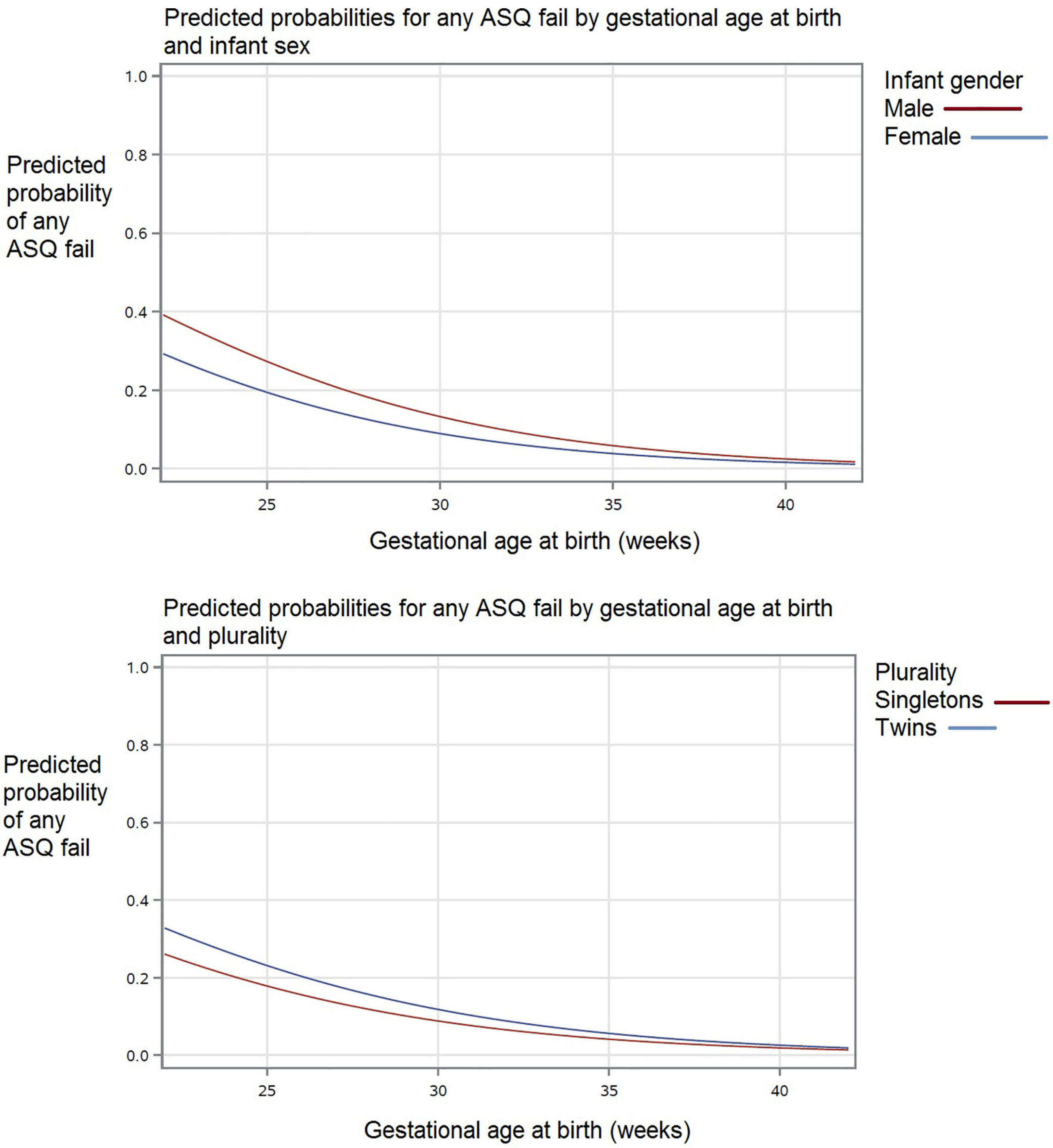

Figure 1.

Predicted probability of any ASQ failure by gestational age at birth, stratified by infant gender (A) and plurality (B).

Panel A shows the unadjusted probability of ASQ failures (for any domain) vs. gestational age at birth (measured in weeks) stratified by infant gender. Males: OR = 0.84 (95% CI:

0.81, 0.87) per week of gestational age. Females: OR = 0.84 (95% CI: 0.80, 0.87) per week of gestational age. Panel B shows the unadjusted probability of ASQ failures (for any domain) vs. gestational age (measured in weeks) stratified by plurality. Singletons: OR = 0.81 (95% CI: 0.78, 0.85). Twins: OR = 0.87 (95% CI: 0.82, 0.91). Unadjusted predicted probability of ASQ failure was computed by dividing the OR by one plus the OR.

Table 1:

Baseline characteristics among study population by preterm (< 37 weeks) status and plurality in the Upstate KIDS Study (2008–2010)[a]

	Singletons, n (%)		**Twins, n (%)**		**All, n (%)**
Baseline characteristic	**Preterm**	**Term**	**Preterm**	**Term**	
No.	560 (14.7)	3246 (85.3)	771 (73.6)	276 (26.4)	4853 (100)
Male newborn	295 (52.7)	1690 (52.1)	399 (51.8)	125 (45.3)	2509 (51.7)
Birth weight, mean (SD), g [b]	2716 (706)	3495 (450)	2280 (576)	2901 (368)	3179 (691)
Maternal Age, mean (SD), y [b]	30.4 (6.4)	30.1 (6.1)	31.4 (5.9)	31.8 (5.7)	30.4 (6.1)
Paternal Age, mean (SD), y [b]	32.9 (7.0)	32.8 (6.8)	33.8 (6.6)	34.7 (6.9)	33.1 (6.84)
Maternal race/ethnicity					
White	433 (77.3)	2611 (80.4)	607 (78.7)	233 (84.4)	3884 (80.0)
Non-white	127 (22.7)	635 (19.6)	164 (21.3)	43 (15.6)	969 (20.0)
Non-Hispanic Black	28 (5.0)	158 (4.9)	48 (6.2)	6 (2.2)	240 (4.9)
Non-Hispanic Asian	15 (2.7)	85 (2.6)	23 (3)	5 (1.8)	128 (2.6)
Hispanic	40 (7.1)	199 (6.1)	49 (6.4)	9 (3.3)	297 (6.1)
Mixed race or ethnicity / Other	44 (7.9)	193 (5.9)	44 (5.7)	23 (8.3)	304 (6.3)
Maternal education					
Less than College	135 (24.1)	625 (19.3)	127 (16.5)	47 (17.0)	934 (19.2)
College or more	425 (75.9)	2621 (80.7)	644 (83.5)	229 (83.0)	3919 (80.8)
Private insurance	407 (72.7)	2393 (73.7)	613 (79.5)	217 (78.6)	3630 (74.8)
Married / living as married	468 (83.6)	2744 (84.5)	641 (83.1)	239 (86.6)	4092 (84.3)
Any alcohol during pregnancy [b]	52 (9.3)	432 (13.3)	77 (10.0)	31 (11.2)	592 (12.2)
Smoked during pregnancy	83 (14.8)	484 (14.9)	97 (12.6)	25 (9.1)	689 (14.2)
Pre-pregnancy BMI, mean (SD)	26.9 (6.7)	27 (6.8)	27.3 (6.83)	27.3 (6.5)	27 (6.8)
Paternal BMI, mean (SD) [b]	28 (5.2)	28.1 (5.5)	28.9 (5.6)	27.7 (4.9)	28.2 (5.4)
Previous live birth	264 (47.1)	1456 (44.9)	368 (47.7)	103 (37.3)	2191 (45.1)
Start prenatal care by 1st trimester [b]	419 (74.8)	2527 (77.8)	576 (74.7)	221 (80.1)	3743 (77.1)
History of infertility treatment [b]	174 (31.1)	824 (25.4)	316 (41.0)	103 (37.3)	1417 (29.2)
Maternal history of hypertension [b]	100 (17.9)	250 (7.7)	139 (18.0)	25 (9.1)	514 (10.6)
Diabetes [b]					
Pre-pregnancy diabetes	15 (2.7)	25 (0.8)	7 (0.9)	1 (0.4)	48 (1.0)
Gestational diabetes	73 (13)	282 (8.7)	82 (10.6)	26 (9.4)	463 (9.5)
Admitted to NICU [b]	166 (29.6)	119 (3.7)	369 (47.9)	16 (5.8)	670 (13.8)
Breast milk only	68 (12.1)	541 (16.7)	30 (3.9)	23 (8.3)	662 (13.6)
Formula only	300 (53.6)	1467 (45.2)	471 (61.1)	159 (57.6)	2397 (49.4)

[a] Missing data: paternal age (n = 352), private insurance (n = 4), married/living as married (n = 219), any alcohol during pregnancy (n = 2), smoked during pregnancy (n = 2), pre-pregnancy BMI (n = 11), paternal BMI (n = 561), previous live birth (n = 37), history of infertility treatment (n = 1), pre-pregnancy diabetes (n = 69), feeding (n = 398).

[b] $p < .05$ for comparisons between preterm and term groups.

Table 2:

Adjusted odds ratios with 95% CI for ASQ fails overall and by each domain from 4 to 36 months vs. gestational age, Upstate KIDS

	Adjusted Model 1[a]
Any fail	0.85 (0.82, 0.88) *
Fine motor	0.84 (0.80, 0.88) *
Gross motor	0.79 (0.75, 0.83) *
Communication	0.83 (0.79, 0.86) *
Personal social	0.87 (0.82, 0.89) *
Problem solving	0.87 (0.83, 0.92) *

[*] p-value < .0001

[a] Model 1 adjusted for: maternal age, child sex, maternal education, maternal race, smoked during pregnancy, any alcohol during pregnancy, pre-pregnancy BMI, plurality.

Table 3:

Odds ratios (95% CI) for ASQ fails overall and by each domain from 4 to 36 months by gestational age at birth (weeks), Upstate KIDS

	ASQ failures		ASQ failures		ASQ failures	
	aOR	95% CI	aOR	95% CI	aOR	95% CI
Gestational age (weeks)	Any domain fail		Fine-motor		Gross-motor	
< 32	5.32	(3.42, 8.28) *	5.06	(2.89, 8.87) *	13.08	(6.62, 25.85) *
32 – 34	2.43	(1.60, 3.69) *	2.44	(1.35, 4.41) *	4.28	(2.13, 8.59) *
35–36	1.38	(1.00, 1.90) *	1.62	(1.04, 2.52) *	1.90	(1.09, 3.29) *
37	1.37	(0.98, 1.90)	1.30	(0.83, 2.04)	1.89	(1.08, 3.30) *
38	1.29	(0.99, 1.67)	1.11	(0.76, 1.62)	1.37	(0.86, 2.19)
39	1.00	Reference	1.00	Reference	1.00	Reference
40	0.73	(0.55, 0.96) *	0.79	(0.53, 1.18)	0.87	(0.54, 1.42)
41 or more	0.51	(0.32, 0.82) *	0.38	(0.16, 0.89) *	0.85	(0.41, 1.79)
	ASQ failures		ASQ failures		ASQ failures	
	aOR	95% CI	aOR	95% CI	aOR	95% CI
Gestational age (weeks)	Communication		Personal-social		Problem solving	
< 32	6.96	(3.97, 12.19) *	3.57	(1.99, 6.41) *	3.29	(1.78, 6.09) *
32 – 34	4.13	(2.39, 7.15) *	1.65	(0.90, 3.04)	1.98	(1.08, 3.62) *
35–36	2.53	(1.62, 3.95) *	1.12	(0.70, 1.78)	1.21	(0.75, 1.96)
37	2.19	(1.41, 3.41) *	0.96	(0.60, 1.53)	1.02	(0.62, 1.68)
38	1.62	(1.11, 2.35) *	1.00	(0.69, 1.45)	1.13	(0.76, 1.67)
39	1.00	Reference	1.00	Reference	1.00	Reference
40	1.01	(0.68, 1.50)	0.65	(0.43, 0.98) *	0.77	(0.51, 1.17)
41 or more	0.76	(0.39, 1.48)	0.72	(0.39, 1.34)	0.53	(0.25, 1.13)

* < .05

Models were adjusted for: maternal age, child sex, maternal education, maternal race, smoked during pregnancy, any alcohol during pregnancy, pre-pregnancy BMI, plurality.

Table 4.

New York State Early Intervention Program Eligibility by Gestational Age, Upstate KIDS

Gestational age (weeks)	**Unadjusted Odds Ratio (95% CI)**	**Adjusted Odds Ratio[*] (95% CI)**
< 32	4.52 (3.15, 6.47)	4.19 (2.80, 6.25)
32 – 34	2.37 (1.69, 3.32)	2.10 (1.42, 3.09)
35–36	1.45 (1.11, 1.91)	1.29 (0.95, 1.76)
37	1.33 (1.00, 1.76)	1.20 (0.89, 1.63)
38	1.08 (0.84, 1.37)	1.01 (0.79, 1.30)
39	1.00 (ref)	1.00 (ref)
40	0.91 (0.71, 1.17)	0.92 (0.71, 1.19)
41 or more	0.77 (0.52, 1.13)	0.78 (0.53, 1.16)

[*] Model were adjusted for: maternal age, child sex, maternal education, maternal race, smoked during pregnancy, any alcohol during pregnancy, pre-pregnancy BMI, plurality.