Neonatal Morbidity at Term, Early Child Development, and School Performance: A Population Study

Jason P. Bentley, MBiostat, Francisco J. Schneuer, PhD, Samantha J. Lain, PhD, Andrew J. Martin, PhD, Adrienne Gordon, PhD, Natasha Nassar, PhD

OBJECTIVES: Investigate the association between severe neonatal morbidity (SNM) and child development and school performance among term infants.

METHODS: The study population included term infants without major congenital conditions born between 2000 and 2007 in New South Wales, Australia, with a linked record of developmental assessment at ages 4 to 6 years in 2009 or 2012 (n = 144,535) or school performance at ages 7 to 9 years from 2009 to 2014 (n = 253,447). Developmental outcomes included special needs or being vulnerable and/or at risk in 1 of 5 developmental domains. School performance outcomes were test exemption, or performing <-1 SD on reading or numeracy tests. Binary generalized estimating equations were used to estimate associations between SNM and outcomes, adjusting for sociodemographic, perinatal, and assessment and/or test characteristics.

RESULTS: Overall, 2.1% of infants experienced SNM. The adjusted odds ratio (95% confidence interval) for SNM and physical health was 1.18 (1.08–1.29), 1.14 (1.02–1.26) for language and cognitive skills, and 1.14 (1.06–1.24) and 1.13 (1.05–1.21) for scoring <-1 SD in reading and numeracy, respectively. SNM was most strongly associated with special needs 1.34 (1.15–1.55) and test exemption 1.50 (1.25–1.81). SNM infants born at 37 to 38 weeks’ gestation and who were small for gestational age had the greatest likelihood of poorer outcomes.

CONCLUSIONS: Term infants with SNM have greater odds of poor neurodevelopment in childhood. These findings provide population-based information for families and can inform clinical counseling and guidelines for follow-up and early intervention.

WHAT’S KNOWN ON THIS SUBJECT: Earlier birth and poor fetal growth are associated with poorer neurodevelopmental outcomes in childhood, even among term births (≥37 weeks’ gestation). However, there are limited long-term data on neurodevelopmental outcomes for term infants who experience neonatal morbidity.

WHAT THIS STUDY ADDS: Term infants who experience neonatal morbidity, even appropriately grown infants born at 39 to 41 weeks’ gestation, have poorer development at school age and school performance in grade 3. Policies for follow-up, specific to these infants’ morbidity patterns, are needed.

Premature birth and poor intrauterine growth are strongly linked to poorer childhood development and school performance.1–4 This is true even among term infants (≥37 weeks’ gestation), when infants born early term (37 and 38 weeks’ gestation)4 or small for gestational age (SGA)5,6 are more likely to have poorer cognitive outcomes. For term-born children, severe morbidities in the first month of life, including infection (particularly sepsis and meningitis), hypoxic–ischemic encephalopathy, and respiratory distress syndrome, may have long-term neurodevelopmental implications.7–9 A Lancet review of 153 studies (n = 22,161) highlighted the increased risk of neurodevelopmental sequelae associated with intrauterine or neonatal insult, with one-third of infants being affected.10 However, the majority of infants (62%) included in the review had insults such as preterm birth or jaundice, the sample sizes of the studies were small (median of 50; interquartile range of 24–113), and most were conducted before 2000 (80%).10

Previous population-based studies using linked administrative data have demonstrated that term infants with severe neonatal morbidity (SNM) have an increased risk of poor child health and decreased survival up to the age of 6 years.11,12 Researchers in these studies used a validated composite measure of SNM (including conditions and procedures, such as seizure, intraventricular hemorrhage, sepsis, ventilation, transfusion, or surgery) ascertained from linked administrative data. Population-based data and a composite indicator are needed for sufficient power and coverage to inform clinical practice and policy about the likelihood of adverse childhood outcomes after SNM. Thus, it is important, particularly in the context of limited resources, to identify those infants who may benefit most from early intervention and follow-up. However, there are currently little long-term data on neurodevelopmental outcomes for term-born infants who experience SNM. Moreover, the likelihood of adverse neurodevelopmental sequelae for infants with SNM and immaturity or poor fetal growth is currently unknown.

We examined the association between SNM among term infants and child neurodevelopment at school entry and school performance both in the presence and absence of immaturity (early-term birth) and poor fetal growth (SGA) and estimated the combined association for SNM, early-term birth, and poor fetal growth.

**METHODS**

**Study Population and Data Sources**

The study population included all live births from 2001 to 2007 in New South Wales (NSW), Australia, of ≥37 weeks’ gestation with a developmental assessment at school entry in 2009 or 2012 (aged 4–6 years) or standardized school test results in grade 3 between 2009 and 2014 (aged 8–9 years). The study population was restricted to infants without major congenital conditions, who were identified by using diagnosis codes from linked hospital records in the first 2 years of life.

Information on births were obtained from 2 sources: (1) the NSW Perinatal Data Collection, a population-based, statutory surveillance system that includes all live births and stillbirths of ≥20 weeks’ gestation or ≥400 g birth weight if gestational age is unknown; and (2) the NSW Admitted Patient Data Collection, which provided information for infants and mothers at the time of birth and for every child admitted to any public or private hospital during childhood.

In Australia, the Australian Early Development Census (AEDC) ascertains child development and school readiness.13,14 Every 3 years since 2009, the AEDC instrument (which is based on the Canadian Early Development Instrument)15 has been used to assess children in their first year of full-time schooling in Australia. Teachers assess children and record information on >100 items, from which scores between 0 and 10 are calculated for 5 major developmental domains: language and cognitive skills, physical health and wellbeing, social competence, emotional maturity, and communication skills and general knowledge.16,17 Results for all children who were assessed in 2009 and 2012 were available for this study. The AEDC also records child demographic information and whether a child has special needs. For details regarding the teacher assessment and definitions of the developmental domains, see Brinkman et al.16

School performance data were obtained from the NSW Department of Education and based on results from the National Assessment Program–Literacy and Numeracy (NAPLAN).18 NAPLAN assesses a child’s basic educational skills in numeracy, reading, writing, spelling, grammar, and punctuation to ensure sufficient attainment to support subsequent learning. Every year in Australia since 2008, all children in grades 3, 5, 7, and 9 register to sit for NAPLAN tests. Results for grade 3 children attending NSW government primary schools from 2009 to 2014 were available for this study. Scores for the reading and numeracy tests were used. NAPLAN data also record demographic information for both parents of each child.

Individual-level birth, hospital, development, and school performance records were probabilistically linked by the NSW Centre for Health Record Linkage.19
and only deidentified data were provided to the researchers. Approval to access, link, and release data for research was obtained from the NSW Population and Health Services Research Ethics Committee and relevant data custodians (reference number 2012-12-430).

**Neonatal Morbidity**

The exposure of interest was SNM. The composite neonatal adverse outcome indicator, which was developed for use with administrative health data by Lain et al, was used to identify infants with SNM. This composite indicator includes a wide range of conditions and procedures observed in severely ill infants at birth or in the first 28 days of life that are reliably reported in routinely collected, population-based, administrative birth and hospital data (Supplemental Table 4). The indicator was developed through expert consultation, validation studies, and a literature review. The composite requires infants to have 1 or more of the conditions or procedures. This provides robustness to misclassification, data entry errors, and underascertainment of individual diagnoses and/or procedures. Any infant who was identified by the composite indicator was considered to have experienced SNM.

**Child Development and School Performance**

Developmental outcomes included whether a child had special needs, was vulnerable or at risk in each developmental domain, or developmentally high risk (DHR). Children with special needs were defined as requiring special assistance because of chronic medical, physical, or intellectually disabling conditions (eg, autism or cerebral palsy). Among children who did not have special needs, national percentile cutoffs for each domain score were used to classify children as being either developmentally vulnerable (≤10th percentile) or at risk (11th–25th percentile) and were considered as 1 group and compared with children who were on track (>25th percentile). DHR children were developmentally vulnerable on ≥2 of the 5 main domains. For school performance, test participation information was used to identify children who were exempt from reading or numeracy tests, representing those with intellectual disability or significant coexisting conditions.

**Covariates**

Information on sociodemographic, perinatal, and assessment- and/or test-related characteristics were ascertained from the study data sources as potential confounders. These included the following: maternal age; marital status; public or private obstetric care; quintiles of area-level, socioeconomic disadvantage for postcode of residence at birth (based on measures of occupation, education and/or qualifications, and unemployment); smoking during pregnancy; parity; labor onset; cesarean delivery; plurality; gestational age categorized as early term (37–38 weeks’ gestation), full term (39–41 weeks’ gestation), or late term (>42 weeks’ gestation); SGA, defined as a birth weight <10th percentile by using national gestational age and sex percentiles; sex; formula-only feeding at discharge; age at and year of assessment and/or test; English as a second language; cumulative days in the hospital after the neonatal period and up to the child’s age at assessment and/or test; and highest parental education (bachelor’s degree or more, diploma or certificate, year 12 and equivalent or less, and unknown or not stated). See also Table 1.

**Data Analysis**

Sociodemographic, perinatal, assessment and/or test characteristics, and development and school performance outcomes of children with SNM were described by using contingency tables. Binary generalized estimating equations with a logit link and exchangeable correlation were used to estimate crude and adjusted associations between SNM and study outcomes, taking into account confounders and the similarity of children attending the same school. To examine the association of SNM with study outcomes in the absence of poor fetal growth, early-term birth, or postterm morbidity, restricted analyses were performed among non-SGA infants born at 39 to 41 weeks’ gestation. We estimated the combined associations of SNM, poor fetal growth (SGA and non-SGA), and gestational age (37–38, 39–41, ≥42 weeks’ gestation) with study outcomes by using the full study population. For covariates, data completeness ranged from 98.9% to 100% except for formula feeding (31.4%) and parental education (29.0%), for which multiple imputation using chained equations was used to account for missing information (PROC MI, fully conditional specification, SAS 9.4; SAS Institute, Inc, Cary, NC). All data and statistical analyses were performed by using SAS 9.4.

**RESULTS**

The final study population included 2 cohorts of children who were born at ≥37 weeks’ gestation without major congenital conditions: those who had a linked developmental assessment record at school age in 2009 or 2012 (n = 144 535) and those who had a school record in grade 3 (from 2009 to 2014; n = 253 447). The average age at assessment and grade 3 testing...
was 5.5 years (SD 0.35) and 8.6 years (SD 0.35), respectively. Overall, 2.1% (7464 of 355 315) of children experienced SNM, and this was similar between the developmental (2.16%) and school performance (2.06%) cohorts. Maternal and perinatal characteristics for infants with and without SNM are presented in Table 1. At school entry, a higher proportion of children who experienced SNM had special needs, were DHR, or vulnerable or at risk in each of the 5 developmental domains (Table 2). Grade 3 children who experienced SNM had significantly increased odds of being DHR (aOR: 1.20; 95% CI: 1.06–1.35) or scoring <25th percentile in physical health and well-being (aOR: 1.18; 95% CI: 1.08–1.29) and language and cognition (aOR: 1.14; 95% CI: 1.02–1.26). SNM was also significantly associated with increased odds of scoring >1 SD below the mean in grade 3 reading (aOR: 1.14; 95% CI: 1.06–1.24) or numeracy (aOR: 1.13; 95% CI: 1.05–1.21). For the analysis restricted to non-SGA infants born at 39 to 41 weeks’ gestation (n = 237753; 66.9%), 1.8% experienced SNM. In the absence of early-term birth, postterm morbidity, and poor fetal growth, adjusted associations with development or school performance were similar to or stronger than those of the main analysis (Table 3).

For all development and school performance outcomes, children who experienced SNM and were born early term and SGA had the highest increased odds of poorer outcomes. The association was strongest for more adverse neurodevelopmental outcomes; the odds of having special needs or test exemption were increased 1.8- and 2.2-fold, respectively (Fig 1). For the other development and school performance outcomes, children who experienced SNM and were born early term and SGA were between 1.2 and 1.7 times more likely to have poorer outcomes (Supplemental Fig 2). An analysis excluding infants who experienced cerebral conditions (seizures, intraventricular hemorrhage, cerebral infarction, periventricular leukomalacia, or hypoxic-ischemic encephalopathy) attenuated the associations with special needs and

<p>| TABLE 1 Maternal, Infant, and Birth Characteristics by SNM |
|---------------------------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Maternal, Infant, and Birth Characteristics</th>
<th>All</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td>N = 353 315</td>
<td>N = 7464 (2.1%)</td>
<td>N = 347 851 (97.9%)</td>
</tr>
<tr>
<td>Maternal age at birth, y</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>&lt;20</td>
<td>16 128 (4.5%)</td>
<td>367 (4.9%)</td>
<td>15 761 (4.5%)</td>
</tr>
<tr>
<td>20–34</td>
<td>270 386 (76.1%)</td>
<td>5570 (74.8%)</td>
<td>264 796 (76.1%)</td>
</tr>
<tr>
<td>≥55</td>
<td>68 795 (19.4%)</td>
<td>1527 (20.5%)</td>
<td>67 268 (19.3%)</td>
</tr>
<tr>
<td>Married or de facto</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>No</td>
<td>66 855 (18.8%)</td>
<td>1563 (20.9%)</td>
<td>65 392 (18.8%)</td>
</tr>
<tr>
<td>Yes</td>
<td>284 623 (80.1%)</td>
<td>5838 (78.2%)</td>
<td>278 785 (80.1%)</td>
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<tr>
<td>Socioeconomic quintile at birth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (lowest disadvantage)</td>
<td>62 801 (17.6%)</td>
<td>1239 (16.6%)</td>
<td>61 562 (17.6%)</td>
</tr>
<tr>
<td>2</td>
<td>67 633 (19.0%)</td>
<td>1499 (20.1%)</td>
<td>66 134 (19.0%)</td>
</tr>
<tr>
<td>3</td>
<td>71 121 (20.0%)</td>
<td>1521 (20.4%)</td>
<td>69 600 (20.0%)</td>
</tr>
<tr>
<td>4</td>
<td>73 017 (20.6%)</td>
<td>1553 (20.8%)</td>
<td>71 464 (20.5%)</td>
</tr>
<tr>
<td>5 (highest disadvantage)</td>
<td>80 804 (22.4%)</td>
<td>1646 (22.1%)</td>
<td>79 158 (22.8%)</td>
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<tr>
<td>Smoked during pregnancy</td>
<td></td>
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<td>289 926 (81.8%)</td>
<td>5886 (80.2%)</td>
<td>283 940 (81.6%)</td>
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<tr>
<td>Yes</td>
<td>65 385 (18.4%)</td>
<td>1478 (18.8%)</td>
<td>63 905 (18.4%)</td>
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<tr>
<td>Private obstetric care</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>248 408 (89.9%)</td>
<td>5510 (73.8%)</td>
<td>242 898 (69.8%)</td>
</tr>
<tr>
<td>Yes</td>
<td>106 167 (29.9%)</td>
<td>1935 (25.9%)</td>
<td>104 225 (30.0%)</td>
</tr>
<tr>
<td>Parity</td>
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<td></td>
<td></td>
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<tr>
<td>0</td>
<td>144 480 (40.7%)</td>
<td>3576 (47.9%)</td>
<td>140 904 (40.5%)</td>
</tr>
<tr>
<td>1</td>
<td>121 857 (34.3%)</td>
<td>2115 (28.3%)</td>
<td>119 744 (34.4%)</td>
</tr>
<tr>
<td>≥2</td>
<td>88 303 (24.9%)</td>
<td>1765 (23.3%)</td>
<td>86 538 (24.8%)</td>
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<tr>
<td>Spontaneous onset of labor</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>No</td>
<td>140 369 (39.5%)</td>
<td>3471 (46.5%)</td>
<td>136 898 (39.4%)</td>
</tr>
<tr>
<td>Yes</td>
<td>214 877 (60.5%)</td>
<td>3992 (53.5%)</td>
<td>210 885 (60.6%)</td>
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<tr>
<td>Cesarean delivery</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>No</td>
<td>265 486 (74.7%)</td>
<td>4721 (63.3%)</td>
<td>260 765 (75.0%)</td>
</tr>
<tr>
<td>Yes</td>
<td>89 601 (25.2%)</td>
<td>7359 (36.7%)</td>
<td>88 862 (25.0%)</td>
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<td>Plurality</td>
<td></td>
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<tr>
<td>Singleton</td>
<td>349 531 (98.4%)</td>
<td>7258 (97.2%)</td>
<td>342 273 (98.4%)</td>
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<tr>
<td>Multiple</td>
<td>5784 (1.6%)</td>
<td>206 (2.8%)</td>
<td>5578 (1.6%)</td>
</tr>
<tr>
<td>Gestational age, completed wk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37–38</td>
<td>81 337 (22.9%)</td>
<td>3300 (50.8%)</td>
<td>79 037 (22.7%)</td>
</tr>
<tr>
<td>39–41</td>
<td>265 876 (74.8%)</td>
<td>4921 (65.9%)</td>
<td>260 995 (75.0%)</td>
</tr>
<tr>
<td>≥42</td>
<td>8102 (2.3%)</td>
<td>243 (3.3%)</td>
<td>7859 (2.3%)</td>
</tr>
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<td>Sex</td>
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</tr>
<tr>
<td>Male</td>
<td>180 743 (50.9%)</td>
<td>4524 (60.6%)</td>
<td>176 219 (50.7%)</td>
</tr>
<tr>
<td>Female</td>
<td>174 572 (49.1%)</td>
<td>3940 (39.4%)</td>
<td>171 632 (49.3%)</td>
</tr>
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<td>SGA</td>
<td></td>
<td></td>
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<tr>
<td>No</td>
<td>317 682 (89.4%)</td>
<td>6396 (85.7%)</td>
<td>311 286 (89.5%)</td>
</tr>
<tr>
<td>Yes</td>
<td>37 519 (10.6%)</td>
<td>1056 (11.3%)</td>
<td>36 463 (10.5%)</td>
</tr>
</tbody>
</table>

* Column percentages may not add to 100% because of missing data.
test exemption, whereas results for the other developmental and school performance outcomes were the same (data not shown).

**DISCUSSION**

Of term infants without major congenital conditions, ~1 in 50 experienced some degree of SNM, which was independently and significantly associated with poorer development at 4 to 6 years of age and poorer school performance at 7 to 9 years of age. This association remained even among term, appropriately grown infants, demonstrating the long-term impact of SNM. Early-term, SGA infants with SNM were the most likely to have poorer neurodevelopmental outcomes, and the strongest associations were for children with special needs and test exemption, for which the contribution of SNM was greater than for early-term birth or SGA. These findings (coupled with other, similar studies) provide population-based evidence that SNM is associated with poor neurodevelopment and increased risk of mortality and morbidity in childhood.11,12,24

Regardless of gestation or SGA, SNM was associated with increased odds of poorer outcomes. These associations were significant after adjusting for confounders and in the restricted analysis for specific needs; overall development (DHR); developmental domains for language, cognition, communication, and physical health (which includes gross and fine motor skills); test exemption; and poor performance on standardized reading and numeracy tests. Our main findings are consistent with those reported in the *Lancet* review by Mwaniki et al,10 although their study also included preterm birth as a morbidity. No researchers in previous studies among term births have investigated overall neonatal morbidity, although a few have investigated specific conditions. These studies found associations between hypoxic-ischemic encephalopathy and intellectual, verbal, and motor deficits at 8 to 16 years of age even among children without a major disability,25 surgery and poor development at age 3 years,26 intraventricular hemorrhage and poorer neurologic outcomes at ages 1 to 5 years,27-29 meningococcal meningitis and poorer neurodevelopment at ages 3 to 12 years,30 and poorer neurodevelopment for newborns affected by respiratory problems.31 These previous studies focused on specific outcomes and morbidities and therefore, unlike ours, had small sample sizes (typically <100 subjects), measured single outcomes often across a wide age range (eg, 3–12 years old), and lacked population coverage.

Our population-based findings provide general, robust, and reliable information for best-evidence guidelines and policy. Furthermore, the additional analysis of the combination of SNM, SGA status,
and gestational age identified SGA infants born early term (37–38 weeks’ gestation) with SNM as having the greatest risk of poor child neurodevelopment. These estimates are particularly useful for population health policy development and evaluation because they take into account other, well-established population markers of poor neurodevelopment, poor fetal growth and early-term birth,4–6 and can be used to provide more tailored information to both clinicians and families.

This study highlights the importance of high-quality data collection systems for routine monitoring and surveillance of maternal and infant outcomes. There is a critical need to improve investment in and strengthen population-based surveillance and data collection across all settings but especially in low- and middle-income countries because these lead to improved health outcomes.32 Importantly, the composite indicator we used in this study was specifically developed to not include measures of service provision (eg, length of stay or NICU admission), which may differ across settings because of resource and/or service availability or policy.

An important finding of our study is that SNM was most strongly associated with those outcomes that identified children with a physical and/or intellectual disability (special needs or test exempted) and more strongly so than early-term birth or SGA. This finding likely reflects the fact that the conditions and procedures included in the composite indicator are associated with physical and intellectual disability. Among term births, previous studies have reported significant associations of autism spectrum disorder, cerebral palsy, epilepsy, and overall intellectual disability with birth asphyxia, neonatal seizures, respiratory distress syndrome, and neonatal infections (eg, meningitis or sepsis).33,34 Given that autism spectrum disorder, cerebral palsy, epilepsy, and other intellectual disabilities are usually only reliably diagnosed later in infancy or childhood,35 our findings suggest that SNM may be a potential marker for these children, particularly at a population level.

To date, there is little population-based outcome information available for term infants with SNM, who are sometimes overlooked because they are term despite having an increased likelihood of poorer neurodevelopmental outcomes. This paucity of evidence makes it difficult to inform policies and guidelines for patient counseling and follow-up. Although we have shown that SNM identifies a relatively small group of children (∼2000 per year), limited resources and funding will preclude complete follow-up. Hence, it is important to identify those at-risk infants who are most likely to benefit from additional support. There is a clinical consensus for the routine follow-up of term infants who experience hypoxic-ischemic encephalopathy36; beyond this, however, agreement varies. The extent of follow-up for term infants who experience other forms of SNM and are of neurologic concern (and information for their parents) varies according to local policy and resource availability.37 Specialized follow-up programs for at-risk infants are recommended,37 and there is some evidence that early-childhood interventions can improve development.38–40 At a minimum for the children we have identified,

![FIGURE 1](https://example.com/figure1.png)

The combined associations for SNM, SGA, and gestational age with having special needs or being exempt from standardized tests. A. Special needs. B. Standardized numeracy or reading test exemption. A comparison at ≥42 weeks’ gestation is not shown because of the small number of events (<10) among children with SNM. The referent value is not SGA, without SNM, born at 39 to 41 weeks’ gestation. We adjusted for maternal age at birth, marital status, type of obstetric care, socioeconomic status quintile at the time of birth, smoking during pregnancy, parity, spontaneous onset of labor, cesarean delivery, plurality, sex, age at assessment and/or test, year of assessment and/or test, English as a second language, cumulative time in the hospital, formula-only feeding, and parental education. All estimates account for clustering in schools.
recommendations include parental programs and enrollment in day care and preschool.41 Ultimately, a comprehensive, multisectoral, and integrated follow-up of high-risk infants within the framework of routine education and health assessments is needed.

SNM was identified by using a validated composite indicator designed for use with routinely collected data.29 The AEDC instrument has undergone extensive development and testing and has demonstrated reliability and validity.42,43 NAPLAN tests undergo a rigorous, 18-month development and quality-assurance process to ensure that standardized results are reliable.44,45 By using a large, population-based cohort and a composite indicator, we were able to examine the impact of a range of neonatal morbidities that would be too rare to study in isolation among term infants without congenital conditions, within a subgroup and in combination with other risk factors. Although a formal validation of the composite indicator we used with child neurodevelopmental outcomes has not been conducted, reliability was demonstrated by being most strongly associated with outcomes that identify children with a physical and/or intellectual disability (special needs or test exempted) and the consistency of our findings across different neurodevelopmental domains, assessment ages, and cohorts. Because the indicator used for SNM is a composite of many conditions and procedures, not all infants may experience the same degree of morbidity. In using routinely collected data, we were not able to include every potentially relevant confounder (eg, nutrition or social interventions in childhood).

CONCLUSIONS
SNM is a population marker for poor development at school age and poor school performance at ages 7 to 9 years among term-born children and is most strongly associated with adverse neurodevelopmental outcomes. SGA infants born early term and experiencing SNM were the most at risk of poor outcomes. These findings provide robust and population-based information for clinical counseling and to inform policies and guidelines for the follow-up of at-risk infants. The identification of infants who have experienced SNM provides the opportunity for targeted, early interventions to support appropriate development in childhood and requires a comprehensive, multisectorial, and integrated approach.

ACKNOWLEDGMENTS
We acknowledge and thank the NSW Ministry of Health, the AEDC, and the NSW Department of Education for providing access to population health, development, and education data, respectively, and the NSW Centre for Health Record Linkage for linking the data sets. The AEDC is funded by the Australian Government Department of Education and Training. The findings and views reported in this study are those of the authors and should not be attributed to these departments.

ABBREVIATIONS
AEDC: Australian Early Development Census
aOR: adjusted odds ratio
CI: confidence interval
DHR: developmentally high risk
NAPLAN: National Assessment Program–Literacy and Numeracy
NSW: New South Wales
SGA: small for gestational age
SNM: severe neonatal morbidity

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Data Supplement at:
http://pediatrics.aappublications.org/content/suppl/2018/01/02/peds.2017-1726.DCSupplemental