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Academic, Social, and Behavioral Outcomes at Age 12 of Infants Born Preterm

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Abstract

The effects of gradient levels of perinatal morbidity on school outcomes have been investigated at age 12 in four preterm groups, classified as healthy (no medical or neurological illness), medical morbidity, neurological morbidity, and small-for-gestational-age (SGA), and a full-term comparison group. Teachers report on academic competence, social skills, and problem behaviors. Data on school type, classroom setting, and school service use are gathered from school records. Preterm groups are found to be equivalent to full-term peers in social skills and problem behavior. Preterm groups with neurological and SGA morbidity have the lowest academic competence scores. Unexpectedly, preterm infants with medical morbidity have higher academic competence scores compared with the other preterm groups. School service use increases with greater perinatal morbidity and is contingent on multiple rather than single indicators of perinatal morbidity. Continued monitoring of preterm infants through early adolescence will ensure that appropriate school services and resources are available to maximize their school success.

Keywords

premature infants; academic competence; social skills; problem behaviors; early adolescents

Early adolescence (ages 11–14) is wrought with major changes, including pubertal growth, transfer from elementary to middle school, and a shift from family-focused to peer-centered relationships (Grotevant, 1998; Masten, Burt, & Coatsworth, 2006; Ryan & Shim, 2008; Stuart, Fondacara, Miller, Brown, & Brank, 2008). Compounding these transitions, schoolwork becomes increasingly complex while socially appropriate behavior within the school setting

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is emphasized (Ryan & Shim, 2008). These developmental tasks are exceptionally challenging to formerly preterm infants because, as a group, they lag behind their full-term peers in academic grades, use more school services (e.g., physical, occupational, speech and language therapies, adaptive physical education, reading and math resources), have poor social skills, and more problem behaviors from preschool to early adolescence (Botting, Powls, Cooke, & Marlow, 1998; Levy-Shiff, Einat, Mogilner, Lerman, & Krikler, 1994; Taylor, Klein, Minich, & Hack, 2000; Walther, den Ouden, & Verloove-Vanhorick, 2000). These reports, however, used single indicators of perinatal morbidities, such as birth weight, gestational age, or specific peri-natal illnesses, to predict school outcomes. Oftentimes, though, preterm infants are born with multiple rather than single perinatal insults. Thus, it is unknown how preterm infants with various degrees of perinatal morbidity perform in school during early adolescence. The current study uses a prospective, longitudinal design to examine three school outcomes at age 12 in a heterogeneous sample of preterm infants and a full-term comparison group. School outcomes include (a) academic competence (including school service utilization), (b) social skills, and (c) problem behaviors.

Prematurity, Perinatal Morbidity, and Later School Outcomes

Advances in neonatal medicine have increased survival rates of preterm infants without an associated decrease in morbidity (Taylor, Klein, & Hack, 2000). Morbidities include medical and neurological conditions afflicting the lungs, brain (e.g., hypoxia, ischemia, periventricular or intraventricular hemorrhage [IVH]), sepsis, and/or periventricular leukomalacia (Peterson et al., 2000; Stewart et al., 1999). Perinatal morbidities have been consistent predictors of learning impairments and school service use at elementary school age (Marlow, Wolke, Bracewell, & Samara, 2005; Taylor, Klein, & Hack, 2000). There is only one report using a multiple morbidity approach in examining later school outcomes of preterm infants. A neonatal risk index was constructed and included perinatal morbidities of apnea, septicemia, jaundice, necrotizing enterocolitis (NEC), chronic lung disease, and IVH (Taylor, Klein, Schatschneider, & Hack, 1998). Lower cognitive scores, lower academic achievement, poorer social competence, and greater problem behaviors were reported at age 8 for those with higher neonatal risk index scores (Taylor et al., 1998). This was the first report demonstrating the adverse effects of multiple perinatal morbidities on school outcomes at age 8 in preterm infants. It failed, however, to disentangle medical from neurological morbidities, or to include preterm infants born healthy or small for gestational age. The current study will expand the literature by including four perinatal-specific groups of infants born preterm in understanding school outcomes at age 12.

Follow-up studies at elementary school age of medically fragile preterm infants (e.g., bronchopulmonary dysplasia [BPD], NEC, sepsis, respiratory distress syndrome [RDS]) report poor school outcomes, perhaps because of their susceptibility to disabilities that interfere with development (Anderson & Doyle, 2006; Gray, O'Callaghan, & Rogers, 2004; Manjemer et al., 2000; Schulzke, Deshpande, & Patole, 2007). For example, preterm infants who had BPD had more motor problems at elementary school age than full-term peers (Gray, O'Callaghan, & Poulsen, 2008; Manjemer et al., 2000). Motor and visual-motor disabilities have been linked to poor school performance, learning problems, social skills, inattention, and problem behaviors (Davis, Ford, Anderson, & Doyle, 2007; Gray et al., 2008; Manjemer et al., 2000). A report of the current sample predicted poor academic achievement at age 8 from motor problems at age 4 (Sullivan & McGrath, 2003). Preterm infants who developed BPD had "soft signs" of neuromotor problems leading to difficulties in sustaining attention and delays in math and language (Manjemer et al., 2000). A gradient effect in severity of BPD or NEC with school outcomes was found, such that as morbidity increased, motor problems, attention problems, and school service use also increased at age 8 (Schulzke et al., 2007; Short et al., 2003). These findings translate to poor school performance, difficulty in math and language ability, an

inability to attend to a task, behavioral problems with peers and educators, and a need for school services, specifically occupational, physical, and speech and language therapies (Schaap et al., 1999; Schulzke et al., 2007; Short et al., 2003). To date, evidence is lacking on whether medically fragile preterm infants continue to have school difficulty as they reach early adolescence or whether they catch up with their peers.

Preterm infants who are neurologically compromised (e.g., IVH, meningitis, hydrocephalus) have the gravest of school outcomes. Neurosensory disabilities, such as cerebral palsy and other motor impairments, directly affect school outcomes (Vollmer et al., 2006). Preterm infants who develop severe IVH (grades III and IV) and/or hydrocephalus often have lower cognition, poor academic achievement, and school service use because of motor impairments and/or learning disabilities from preschool to elementary school age (Linguist, Carlsson, Persson, & Uvebrant, 2005; Sherlock, Anderson, & Doyle, 2005). No one has examined social skills or problem behaviors for children who had this type of perinatal morbidity. This will be the first examination of school outcomes at age 12 of preterm infants with neurological morbidities.

The cascading effects of prematurity, size at birth, and potential presence of perinatal illness (es) contribute to poor school outcomes in preterm infants born small-for-gestational-age (SGA; less than 10th percentile for body length; Hollo et al., 2002; Lundgren & Tuvemo, 2008; Schothorst & Van Engeland, 1996). Unique to preterm infants born SGA is the lower brain volume and cortical grey matter because of their immature size at birth (Martinussen et al., 2005). These neurological deficits predicted lower cognition, poor social competence, learning disabilities, and problem behaviors at elementary school age (Lundgren & Tuvemo, 2008; Schothorst & Van Engeland, 1996). Socially inappropriate behaviors present at ages 6 and 8 predicted later poor school performance and social competence at age 11 (Schothorst & Van Engeland, 1996). One report found that infants born SGA had increased rates of visual-perceptual problems and lower attention in the school setting, were less timid and socially inappropriate, and had more learning problems and problem behaviors (e.g., conduct problems, hyperactivity, inattentive-passive) than full-term peers, which predicted poor academic achievement at age 10 (Hollo et al., 2002). This will be the first report to investigate school outcomes at age 12 of infants born SGA compared with three other perinatal morbidity groups and a full-term group.

Preterm infants born without medical or neurological morbidity may, during the neonatal period, be at risk for cardiopulmonary, respiratory, gastrointestinal, brain, hyperbilirubinemia, or immune distresses (Medoff-Cooper, Bakewell-Sachs, Buus-Frank, & Santa-Donato, 2005; Raju, Higgins, Stark, & Leveno, 2006). This healthy perinatal group, which includes infants born late preterm (34–36 weeks' gestational age) or moderate preterm (32–34 weeks' gestational age), currently contribute the greatest proportion to the rising rate of preterm births (Raju et al., 2006). Because this is a recent phenomenon, research evidence on their long-term developmental outcomes is still evolving. Preliminary reports suggest that preschoolers had delays in school readiness (Adams-Chapman, 2006). At elementary school age, they had poor school performance including delays in language development (Chyi, Lee, Hint, Gould, & Sutcliffe, 2008; Magill-Evans, Harrison, Van der Zalm, & Holdgrafer, 2002) and visual-spatial skills (Magill-Evans et al., 2002), calling for Individual Education Plans (IEPs) and use of school services in Grades 3 to 5 (Chyi et al., 2008). Given this evidence, examination of school outcomes in early adolescence of preterm infants born healthy is warranted.

The gradient effect of preterm infant perinatal morbidities, from healthy to neurological illness, on school outcomes at early adolescence has not been thoroughly evaluated. The primary aim of this study is to comprehensively examine school outcomes at age 12 of academic competence, school service use, social skills, and problem behaviors in a sample of preterm

infants born with various perinatal morbidity. The hypothesis states that preterm infants who had more perinatal morbidity (neurological, medical, SGA) will have poorer school outcomes at age 12 compared with preterm infants born healthy and the full-term group. Specifically, a gradient hypothesis is tested such that preterm infants with the most morbidity (neurological, medical, SGA) will have the lowest academic competence and social skills and the highest rate of school service use and problem behaviors at age 12 compared with infants born full-term. Preterm infants without morbidity will do better in school outcomes at age 12 but not as well as their full-term peers. Study results have the potential to better identify children who need additional supportive school services because of the severity of perinatal morbidity experienced as preterm infants.

Method

Participants

Two hundred thirteen infants were recruited at birth from 1985 to 1989 from a Level III neonatal intensive care unit in a specialty hospital in southern New England. Parents were invited to participate by research nurses. The criteria for recruitment were neonatal diagnoses, birth weight <1,850 g, absence of maternal mental health illness, and English as a primary language. Five groups were classified by perinatal morbidity and stratified by socioeconomic status (SES). Full-term infants (FT; $n = 45$) were born from mothers with uncomplicated labor and deliveries and recruited from the same medical center at the same time as preterm infants. All preterm infants were born at less than 37 weeks' gestational age and classified into four subgroups based on their perinatal morbidities. Healthy preterm infants ($n = 26$) had no medical or neurological complications. Preterm infants with medical illness group (MPT; $n = 48$) had BPD, RDS, NEC, and/or sepsis. Preterm infants with neurological illness (NPT; $n = 31$) had Grade III and IV IVH, meningitis, and/or shunted hydrocephalus. Preterm infants with birth weights below the 10th percentile for length formed the SGA ($n = 30$) group.

Infants were seen at 1, 18, and 30 months and at ages 4, 8, and 12 years. Retention was high from birth to age 4 (89%), age 8 (88%), and age 12 (87%; $N = 186$). The excellent retention rate is due to a multifaceted approach in tracking participants by contact with parent(s), next of kin, and friends, frequent newsletter mailings, national directory assistance (i.e., 411), Internet directories, and Web-based people search systems. Those who dropped from the study between the birth time point and age 12 were 10 full-term infants, 6 healthy preterm infants, 8 medical preterm infants, 2 neurological preterm infants, and 1 preterm infant small for gestational age. No differences were found between those who participated and those who dropped at age 12 in neonatal illness, SES, parent education, occupation, marital status, age, or race. However, more male infants ($n = 20$) than female ($n = 7$) dropped from the study at age 12, $\chi^2(1, 213) = 6.76, p < .001$. For school performance outcomes, most teachers (85%-87%; $N = 159$ –162) reported on academic competence, social skills, and problem behaviors within the school setting. Infants with missing teacher report data had lower SES, $t(179) = 4.12, p < .001$, and their mothers had lower education, $t(177) = 2.80, p < .005$.

Measures

Academic competence and social skills—The Social Skills Rating Scale (SSRS; Gresham & Elliott, 1990) was used to capture academic competence and social skills for children in preschool to Grade 12 within the classroom setting. Social skills are specific behaviors that a child exhibits in specific situations to perform competently on social tasks. For the academic competence subscale, teachers rated children on nine items in the areas of reading, math, learning behaviors, and general cognitive functioning compared with other students in the same classroom on a 5-point scale (*lowest = 10%, next lowest = 20%, middle = 40%, next highest = 20%, highest = 10%*). The social skills subscale consists of 30 items.

Teachers reported the frequency of social behaviors including, cooperation, assertion, and self-control on a 3-point scale (*never, sometimes, very often*). Raw scores for both sub-scales were converted to standard scores and used in this analysis. Gresham and Elliot report internal consistency of .95 for academic competence and .93 to .94 for social skills. The test-retest reliability was .93 for academic competence and .85 for social skills. Content, social, criterion-related, construct, and discriminant validities were supported.

Problem behaviors—Teachers reported the frequency of problem behaviors on a 3-point scale (*never, sometimes, often*) on the Teacher Report Form (TRF; Achenbach & Rescorla, 2001). Eight syndrome subscales yield a total problem behaviors standard score and used in this analysis. Subscales included withdrawn, somatic complaints, anxious or depressed, social problems, thought problems, attention problems, delinquent behavior, and aggressive behaviors. Achenbach and Rescorla report internal consistency of .97 for the standard score and test-retest reliability of .90. Content, criterion-related, construct validities were strongly supported.

School setting and services—Variables of school type (public, private, vocational, alternative, special education, home schooling), classroom setting (regular, resource, self-contained), absenteeism, tardiness, school transfers, IEP, and type of school services were collected from the child's school records by study examiners. A regular classroom is a traditional setting with same-age peers. In a resource setting, the child is removed from their regular classroom for a scheduled class where a special educator works individually with children on their IEP goals. Examples of resource assistance include assistance in reading, math, and written language. A self-contained classroom is composed of children with special education needs. School services included physical therapy, occupational therapy, speech and language therapy, and adaptive physical education.

Procedures

Neonatal data were collected from medical charts. As part of a longitudinal follow-up study, school visits were made at age 12 to collect academic data on core curriculum subjects, grade promotion, attendance, tardiness, school transfers, and school service use. Middle school students have multiple teachers; therefore, study participants were asked to nominate a teacher who knew them best. Teachers completed questionnaires on academic competence, social skills, and problem behaviors. Examiners were blind to perinatal group status at all time points. Informed consent was obtained from parents at each time point and child assent was obtained at age 12. Each time point was approved by university and hospital institutional review boards.

Analysis

Pearson product-moment correlations were used to examine the relationship between academic competence, social skills, and problem behaviors for multicollinearity, ensuring that correlations did not exceed .70. An analysis of variance (ANOVA) was used to test mean differences between the five perinatal morbidity groups (FT, HPT, MPT, NPT, SGA) on academic competence, social skills, and problem behaviors. A chi-square analysis examined distributional differences between the perinatal morbidity groups for school type, classroom setting, absenteeism, tardiness, school transfers, and use of school services.

Results

The sample was 88% White, 9% Black, and 3% Hispanic American, and 54% were female. At birth, the FT group had the highest birth weight and gestational age compared with all perinatal morbidity groups (see Table 1). The NPT group had a longer length of stay in the

NICU and a higher neonatal risk score than the MPT, SGA, and HPT perinatal groups (see Table 1).

At age 12, socioeconomic status did not differ between the five perinatal groups, $\chi^2(16, 181) = 9.3, p > .05$. The majority of mothers completed high school (93%, $n = 166$), 72% ($n = 133$) were married or cohabiting with a partner, and 83% ($n = 148$) were employed. Thirty-three Rhode Island school districts ($n = 132$), 18 Massachusetts districts ($n = 35$), and 19 districts outside of the northeast region were visited when participants were age 12. The majority of the early adolescents were in a public (86%) middle school (77%) setting. Most of the sample (93%) had a school attendance rate above 90%, $\chi^2(4, 163) = 2.89, p > .05$. Only 25% of the sample ($n = 44$) had 1 or more school transfers, $\chi^2(4, 178) = 1.07, p > .05$. Eight percent of the sample had more than five occurrences of tardiness (FT = 9, HPT = 1, MPT = 1, NPT = 2), $\chi^2(4, 159) = 15.003, p < .005$.

Correlation of School Outcomes

Small to moderate correlations were in the expected direction and ranged from $-.60$ to $.55$. Academic competence was moderately correlated with social skills, $r = .55, p < .001$, and problem behaviors, $r = -.55, p < .001$. Social skills was negatively correlated with problem behaviors, $r = -.60, p < .001$. Thus, there was some overlap among the three school outcome measures, but no multicollinearity as correlations did not exceed $.70$ (Nunnally, 1978).

Perinatal Morbidity Group Differences in School Outcomes

The gradient hypothesis was partially supported for academic competence; however, an unexpected result was found. The MPT ($M = 98.6, SD = 13.7$) and FT ($M = 98.5, SD = 10.2$) perinatal groups had higher academic performance whereas the SGA group had the lowest scores ($M = 90.2, SD = 12.9$; see Table 2). It was expected that the FT perinatal group would have greater academic competence than the preterm groups. However, it was unexpected that the MPT perinatal group would have the highest academic competence among the preterm groups. There were no differences between perinatal groups in social skills or problem behaviors at age 12.

School services—Seventy percent of the sample was in a regular classroom setting. Fourteen percent to 38% of the formerly preterm infants received school services compared with 9.3% of their full-term peers (see Table 3), $\chi^2(12, 186) = 33.42, p < .001$. Four participants were home schooled (HPT = 1, MPT = 2, NPT = 1). Three did not have school outcome data as there was no “teacher.” One participant was home schooled and received school resources for reading and math in her local public school. This participant, therefore, had school outcome data. As hypothesized, a gradient effect was found for degree of perinatal morbidity and school services use (see Table 3). Preterm infants who had neurological compromise, the NPT perinatal group, had more IEPs than all perinatal groups, $\chi^2(8, 186) = 18.32, p < .01$. More than one quarter of this perinatal group were in self-contained classrooms (students with special education needs) and an additional 21% were receiving school resources. Services were received for occupational therapy, $\chi^2(4, 184) = 16.64, p < .001$, and adaptive physical education, $\chi^2(4, 185) = 4.95, p < .05$. Although not statistically significant, the NPT perinatal group received the most services for physical therapy, $\chi^2(4, 184) = 8.08, p > .05$, and speech and language, $\chi^2(4, 184) = 6.64, p > .05$.

The MPT and SGA perinatal groups were equally represented in school service use, with 33% having an IEP. Almost one third of preterm infants with medical compromise, the MPT perinatal group, received school resources. It was expected that the MPT perinatal group would have the second highest rate of services. This was true for adaptive physical education, with 8% of infants born MPT receiving this school service. However, unexpectedly, this perinatal

group had the least amount of occupational therapy (14%), speech and language therapy (10%), and an equivalent rate of school services for physical therapy as the SGA perinatal group (10%).

One third of infants born SGA received school services. As expected, the SGA perinatal group had more school service compared with the HPT perinatal group, $\chi^2(8, 186) = 18.32, p < .01$. However, unexpectedly, this perinatal group had more services for occupational therapy than the NPT perinatal group, $\chi^2(4, 184) = 16.64, p < .001$. Although not statistically significant, this perinatal group received the second highest rate of speech and language services (20%).

An unexpected finding was the rate of school service use for the HPT perinatal group. Almost one quarter of this perinatal group had an IEP, with 15% receiving resources, 7% in self-contained classroom settings, and 11% receiving speech and language services.

Discussion

Successful mastery of academic competence, social skills, and appropriate behavioral conduct amid the competing challenges of early adolescence can be taxing, particularly for infants born prematurely (Botting et al., 1998; Saigal, Hoult, Streiner, Stoskopf, & Rosenbaum, 2000; Taylor, Klein, Minich, et al., 2000). As hypothesized, preterm infants with more perinatal morbidity (neurological, medical, SGA) had poorer school outcomes at age 12 compared with preterm infants born healthy or full-term. The FT group had higher academic competence scores compared with the preterm groups. Unexpectedly, however, the MPT perinatal group had academic competence scores commensurate with the FT group.

Study results confirmed the hypothesis that infants with the greatest perinatal morbidity (i.e., NPT perinatal group) had the highest rate of school service use in middle school. This is consistent with other findings (Avchen, Scott, & Mason, 2001; Taylor, Klein, Minich, et al., 2000). An earlier report of the current sample at age 8 (McGrath, Sullivan, Lester, & Oh, 2000) and present findings show that one third to approximately one half of preterm infants born MPT, NPT, or SGA had an IEP. Services were provided for occupational therapy, speech and language therapy, adaptive physical education, and resource assistance. These results suggest that academic competence and school service use in early adolescence varies and is contingent on multiple rather than single indicators of perinatal morbidity. Contrary to the hypotheses, perinatal group differences were not found for social skills and problem behaviors.

The FT group had better academic competence compared with the preterm groups, with exception of the MPT perinatal group. Mean academic competence scores for the FT group ($M = 98.5, SD = 10.2$) were comparable to those of standard scores ($M = 100, SD = 15$). The majority of infants born FT were in regular classroom settings at age 12 and had fewer school services compared with the preterm groups.

Preterm infants born healthy (i.e., HPT) did not have medical or neurological compromise at birth. It was anticipated that their school outcomes would mimic that of their FT peers and that in accordance with the gradient hypothesis, they would have the best school outcome scores compared with all preterm groups. Consistent with expectations, most infants in this perinatal group were in regular classroom settings and had similar social skills and problem behavior scores to their FT peers. Nevertheless, although the HPT perinatal group had fewer services compared with other preterm groups, 22% received school services for resource assistance and speech and language services. At elementary school age, infants born HPT received school services because of language delays (Chyi et al., 2008; Magill-Evans et al., 2002). The current report suggests that speech and language difficulty continues into early adolescence for this perinatal group. Unexpectedly, 7% of HPT perinatal group was in a self-contained classroom setting. This finding is of practical and clinical concern. It begs the question, why would healthy, preterm infants be in a self-contained classroom setting? Clearly, results in this report

corroborate existing evidence that infants born HPT would benefit from close monitoring given they are suspect for poor developmental outcomes from preschool to early adolescence. However, the mechanism responsible for deficits in speech and language and overall academic competence for infants born HPT is yet to be understood. The prematurity rate is steadily rising (Martin et al., 2006), with this perinatal group representing 3 of 4 preterm births in the United States (Chyi et al., 2008; Davidoff et al., 2006). Follow-up studies of preterm infants born without medical or neurological compromise are necessary given this increasing rate of preterm births and their need for school services.

Often, preterm infants born with medical morbidities have poor school outcomes (Schulzke et al., 2007; Short et al., 2003) and use more school services at elementary school age (McGrath & Sullivan, 2002; Taylor, Klein, Drotar, Schluchter, & Hack, 2006). In the present sample, an unexpected result emerged. We anticipated a gradient effect of morbidity for school outcomes (NPT < MPT < SGA < HPT). However, preterm infants with multiple medical morbidities performed better than expected in early adolescence. Their academic competence scores were commensurate with FT peers and greater than all preterm groups. One explanation may be the rate of school service use. One third of the MPT perinatal group had an IEP. Eight percent to 15% received services for occupational and/or physical therapy, adaptive physical education, speech and language, and resource assistance. In a post hoc analysis of covariance, school service use was covaried with the main effect of perinatal group on academic competence. School service use did not change the findings for academic competence scores. Use of school services may mitigate, and possibly safeguard, the effects of medical morbidity on later academic competence. This emphasizes the importance of appropriate school services in buffering the effects of medical morbidities for current and future generations of premature infants.

Neurologically compromised preterm infants experience academic challenges at an early age. Perinatal morbidities of IVH and/or hydrocephalus predicted poor academic outcomes and the highest rate of school service use from preschool to elementary school age (Linguist et al., 2005; Sherlock et al., 2008). Previous reports of the current sample at ages 4, 8, and now, age 12, corroborate this finding (McGrath, 1997; McGrath et al., 2000; McGrath & Sullivan, 2003). It was expected that preterm infants with neurological morbidity would have the worst academic competence. Although not significant, their scores were better than the SGA perinatal group. Because more than 25% of this perinatal group was in self-contained classrooms, academic competence scores may not be comparable to that of other preterm infants in regular or resource classroom settings. Consistent with the gradient hypothesis, the NPT perinatal group had the highest IEP rate, with almost half of the group receiving resources and/or specialized services. Although this report did not examine the frequency of motor impairments, the mode of school service use suggests that most infants received services (occupational therapy, physical therapy, adaptive physical education) for motor-related disabilities. This finding is consistent with other reports (Linguist et al., 2005; Sherlock et al., 2008). This is the first report investigating the effects of neurological compromise on social skills and problem behaviors. In this sample, the NPT perinatal group had similar social skills and problem behavior scores to FT peers. Teachers reported on social skills and problem behaviors. The behavior items in the SSRS and TRF questionnaires may have not been appropriate for the NPT perinatal group given their level of disability. For example, children with neurological sequelae are unable to put work materials away or help peers with tasks. Because children in this group are physically unable to engage in these behaviors, they were scored as *not present*. Preterm infants with neurological compromise have the poorest school outcomes and frequent use of school services over time.

Preterm infants born SGA may have a triple jeopardy as they are vulnerable to the additive effects of prematurity (e.g., fetal hypoxia), size at birth (e.g., intrauterine growth retardation,

loss of gray matter, lower brain volume; Martinussen et al., 2005), and perinatal morbidity (e.g., BPD, meningitis, NEC; O'Callaghan, Harvey, Tudehope, & Gray, 1997; van Wassenae, 2005) on school outcomes (Hollo et al., 2002; Lundgren & Tuvemo, 2008; Schothorst & Van Engeland, 1996). As expected, this perinatal group had lower academic competence compared with the FT group. However, academic competence scores for the SGA perinatal group were worse than for preterm infants born with medical and neurological compromise. The cascading effects of prematurity, size at gestation, and morbidity at birth may exacerbate later school performance. Evidence of these effects is found in the use of school services. One third of infants born SGA had an IEP. At age 12, this group had the second highest rate of children in self-contained classroom settings and the highest rate of occupational therapy, and speech and language service use was similar to that of the NPT perinatal group. Preterm infants born SGA are susceptible to motor impairments and/or visual-perceptual problems (Hollo et al., 2002). These impairments have been linked to poor school performance and learning disabilities (Davis et al., 2007), suggesting that preterm infants born SGA require school services because of motor-related disabilities. An earlier report of the current sample found that motor problems at age 4 predicted poor academic achievement at age 8 (Sullivan & McGrath, 2003). Furthermore, these findings underscore grave concern for this perinatal group. Academic difficulties begin at school age and continue into early adolescence, with school performance on par with or worse than preterm infants born with neurological compromise.

Unlike other reports (Schulzke et al., 2007; Short et al., 2003), we did not find perinatal-specific differences on social skills or problem behaviors. Poor social skills and problem behaviors have been found in preterm infants born with medical illness (e.g., BPD, NEC) and SGA (Davis et al., 2007; Hollo et al., 2002; Schothorst & Van Engeland, 1996; Schulzke et al., 2007; Short et al., 2003). There are several possible explanations. First, the existing literature focuses on the effects of single, rather than multiple, indicators of morbidity. Second, others have linked motor impairment with inattention, poor social skills, and problem behaviors (Davis et al., 2007; Manjemer et al., 2000). The relationship between motor impairment and school outcomes was not examined in the current report. Future work should consider the associative or mediating effects of motor ability on social skills and problem behaviors in preterm infants with perinatal morbidity. Third, developmental constructs that directly contribute to, or mediate, social competence or problem behaviors in early adolescence are worth consideration. For example, in early adolescence, one's internal working model of self (e.g., self-efficacy, self-concept) emerges, and thus is developmentally appropriate to capture (Grotevant, 1998). In one study of prosocial behavior, self-efficacy mediated a positive home environment (Bradley & Corwyn, 2001). Moreover, a combination of internal working models of self and internal locus of control are necessary for optimal outcomes of at-risk infants (Werner & Smith, 2001). Further research should include underlying components of family factors, self-concept, and quality of peer relationships in understanding social skills and problem behaviors in formerly preterm infants at early adolescence. Fourth, social skills and problem behaviors were measured exclusively by teacher report. There was a slightly lower return of questionnaires from teachers of early adolescents from lower SES families. Thus, low social skill and problem behavior scores may have been omitted, reducing the score variability. Finally, the sample was not ethnically diverse. Some argue that by definition, social skills are culturally appropriate manifestations of behavior at the opposite end of the problem behavior spectrum. To appropriately measure social skills or competence in early adolescence, interpersonal relationships in several contexts may need to be captured.

Early adolescence is a transition stage with an intricate school context. School performance, socially appropriate behaviors, and relationships with educators and peers are emphasized. This report encapsulates the school context with a heterogeneous sample of teachers from varying schools, districts, and states reporting on school outcomes. The SSRS and TRF were chosen as they are well-developed instruments with excellent reliability and validity.

The results of this report, combined with others (Avchen et al., 2001; Klebanov, Brooks-Gunn, & McCormick, 1994; McGrath et al., 2000; McGrath & Sullivan, 2002; Taylor, Klein, Minich, et al., 2000), present a somber fact—that at least one-third of infants born prematurely will require school services at some point during their education. When perinatal morbidities are considered, different patterns emerge. Given appropriate services, preterm infants born with medical illness perform better than expected in school outcomes at age 12. Conversely and unexpectedly, preterm infants born healthy and SGA perform worse. These results underscore the importance in expanding beyond single indicators of perinatal morbidity when investigating developmental outcomes of prematurity.

Perinatal morbidities of prematurity are appropriate factors to consider in school outcomes at age 12. As the prematurity rate increases, more pre-term infants will inevitably require school services. This report calls to parents, physicians, nurses, social workers, and educators for vigilant monitoring of preterm infants born with morbidities, which will ensure that appropriate school services and resources are available to maximize their success in middle school.

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Table 1

Neonatal Demographics for Age 12 Sample ($N = 186$)

	FT ($n = 43$)	HPT ($n = 27$)	MPT ($n = 52$)	NPT ($n = 34$)	SGA ($n = 30$)	F (df)
Birthweight	3,412 $\pm$ 349 (2,720–4,130) _a	1,481 $\pm$ 219 (900–1,690) _b	1,279 $\pm$ 301 (710–1,800) _c	1,146 $\pm$ 283 (660–1,670) _c	1,162 $\pm$ 374 (640–1,850) _c	396.7 [†] (4, 181)
Gestational age	40 $\pm$ 0.78 (38–43) _a	31 $\pm$ 1.7 (28–34) _b	29 $\pm$ 2.2 (25–33) _c	28 $\pm$ 2.3 (24–33) _d	32 $\pm$ 2.8 (26–36) _b	211.6 [†] (4, 181)
Hobel neonatal risk [*]	1.4 $\pm$ 3.5 (0–15) _c	57.4 $\pm$ 22.8 (20–110) _d	88.8 $\pm$ 25.3 (30–128) _b	114.3 $\pm$ 20.9 (48–160) _a	77.4 $\pm$ 34.3 (8–136) _c	139.4 [†] (4, 181)
Number of days hospitalized	3.0 $\pm$ 0.41 (2–5) _d	31.8 $\pm$ 9.9 (17–60) _c	52.0 $\pm$ 23.7 (17–103) _b	69.5 $\pm$ 23.1 (23–130) _a	59.2 $\pm$ 51.2 (9–274)	39.2 [†] (4, 181)

Note: FT = full term; HPT = healthy preterm; MPT = medical preterm; NPT = neurological preterm; SGA = small-for-gestational-age preterm. Data are given as $M \pm SD$ (range) except where noted. Subscript letters in the body of the table indicate significant differences between perinatal groups; a > b > c.

^{*} Hobel, Hyvarinen, Okada, & Oh (1973).

[†] $p < .001$.

Table 2

School Outcomes at Age 12 by Perinatal Morbidity Group (*N* = 186)

	FT (<i>n</i> = 43)	HPT (<i>n</i> = 27)	MPT (<i>n</i> = 52)	NPT (<i>n</i> = 34)	SGA (<i>n</i> = 30)	<i>F</i> (<i>df</i>)
Social skills	98.3 ± 13.8 (71–131)	96.4 ± 15.9 (60–131)	99.7 ± 15.9 (72–131)	99.9 ± 13.9 (75–130)	94.9 ± 12.2 (72–125)	0.66 (4,157)
Problem behaviors	48.5 ± 9.2 (33–70)	51.6 ± 9.2 (40–74)	50.3 ± 9.6 (33–72)	51.5 ± 8.8 (34–77)	53.5 ± 8.5 (34–66)	1.23 (4,154)
Academic competence	98.5 ± 10.2 (83–116) _a	94.3 ± 12.6 (71–116)	98.6 ± 13.7 (72–131) _a	93.6 ± 10.5 (76–116)	90.2 ± 12.9 (56–116) _b	2.64* (4,155)

Note: FT = full term; HPT = healthy preterm; MPT = medical preterm; NPT = neurological preterm; SGA = small-for-gestational-age preterm. Data are given as *M* ± *SD* (range) except where noted. Subscript letters in the body of the table indicate significant differences between perinatal groups; a > b.

* *p* < .05.

Table 3Class Setting and School Services by Perinatal Morbidity Group ($N = 186$)

	FT ($n = 43$)	HPT ($n = 27$)	MPT ($n = 52$)	NPT ($n = 34$)	SGA ($n = 30$)	χ^2 (df)
Classroom setting, %						
Regular	90.7	74.1	63.5	50.0	66.7	33.42 [‡] (12, 186)
Resource	9.3	14.8	30.8	20.6	20.0	
Self-contained	0	7.4	1.9	26.5	13.3	
Home school	0	3.7	3.8	2.9	0	
Type of school service, %						
Individual education plan	9.3	22.2	32.7	47.1	33.3	18.32 ^{**} (8, 186)
Occupational therapy	0	0	13.7	21.2	23.3	16.64 [‡] (4, 184)
Physical therapy	0	0	9.8	12.1	10	8.08 (4, 184)
Speech/language therapy	4.7	11.1	9.8	21.2	20.0	6.64 (4, 184)
Adaptive physical education	0	0	7.8	14.7	6.7	4.95 [*] (4, 185)

Note: FT = full term; HPT = healthy preterm; MPT = medical preterm; NPT = neurological preterm; SGA = small-for-gestational-age preterm.

* $p < .05$.** $p < .01$.‡ $p < .001$.