Neonatal Intensive Care Unit Graduates: School-age Outcomes and an Analysis of Infant Characteristics

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INTRODUCTION

Although advances in the basic medical care of preterm and low birth weight children have been made, little research has been conducted to determine the long-term behavioral and educational outcomes of these children (Schothorst & Engeland, 1996; Taylor, Klien, Minich, & Hack, 2000). Research suggests that preterm and low birth weight children are faced with many medical challenges, including neonatal cerebral hemorrhages and neurological dysfunction, which increases the likelihood of them developing learning and behavior problems (Beitchtman, Nair, Clegg, Ferguson, & Patel, 1986; Gillberg & Gillberg, 1989; Marlow, Wolke, Bracewell, Samara, 2005; Shaffer, Schonfeld, O'Connor, Stokman, Trautman, & Shafer, 1985). The high survival rates of infants who are extremely premature, of extremely low birth weight, and who are medically ill, has raised questions regarding long term behavioral and educational sequelae. To further complicate matters, there is great heterogeneity among infants in terms of exposure to various conditions (e.g., hemorrhages) as well as various outcomes from the exposure to these adverse conditions.

PURPOSE OF THE STUDY

The purpose of the study was to examine school-age behavioral and educational outcomes of a population of NICU graduates, comparing the outcome of children who were VLBW (birth weight less than or equal to 1500 grams) to those who were non-VLBW (birth weight greater than 1500 grams). The study investigated presumed moderators (e.g., mother's marital status, mother's age, family income) of school-age behavior and educational problems. The study also examined the need for early intervention services and the need for school age service for this population. Additionally, the physical and cognitive characteristics of participants and those unavailable for further study were examined to determine the representative nature of the current sample.

METHOD

Participants

Participants included 70 school-age children (41 VLBW and 29 non-VLBW) who were NICU graduates from a large Midwestern children's hospital. All participants had also been evaluated through a multidisciplinary NICU follow-up clinic at 6-, 12-, and 18-months (corrected age). Additional population characteristics for the participant families are delineated in Table 1.

Measures

NICU General Information Questionnaire. The NICU General Information Questionnaire consisted of demographic questions (i.e., name, gender, race, age of mother at delivery, mother's marital status at time of delivery, mother's current marital status, and family yearly income), current behavioral, developmental, and psychiatric diagnoses, and school history questions including current grade, any grade retention, special education diagnosis, 504 plan services, and when, if at all, their child was recommended for special education services.

Achenbach Child Behavior Checklist (CBCL). The CBCL (Achenbach, 2001) is a parent-completed behavior rating scale consisting of 113 items rated on a 3-point Likert scale (0= "Not true," 1= "Somewhat or sometimes," 2= "Very True or Often True"). A Total Behavior Problem composite score, Internalizing Total Score, and Externalizing Total Score as well as seven subscale scores including Withdrawn, Anxious/Depressed, Social Problems, Thought Problems, and Attention Problems, Delinquent Behaviors, and Aggressive Behavior can be extrapolated from the CBCL. The CBCL gathers information regarding social skills, school functioning, and emotional and behavioral problems.

Behavioral Style Questionnaire (BSQ). The BSQ (Carey & McDevitt, 1995) is a parent-completed 110-item index that measures nine categories of temperament as well as provides a composite temperament style for children age 3-7 years of age. Specifically, the nine indices of temperament measured by the scale include: activity level, regularity, adaptability, initial approach-withdrawal, intensity, mood, persistence, sensory threshold and distractibility. Each item is rated on a 6-point Likert scale and questions are answered in terms of how the child's recent behavior has been like the behavior described by the specific item.

Bayley Scales of Infant Development – II (BSID-II). The BSID-II is a commonly used standardized development assessment for infants from birth to 42 months of age. The BSID-II Mental Scale and Motor Scale were used to assess the cognitive, language, personal-social development, sensory integration, quality of movement, and perceptual-motor integration development of the child. The BSID-II specifies sets of items that are determined by the child's chronological age.

Procedure

A convenience sampling technique was used to identify families of NICU graduates who were of school age (i.e., at least 5 years). There were 331 families who met eligibility criteria for the study. Families were contacted by phone and invited to participate in the study. Families who agreed to participate were then sent a letter introducing the study and inviting them to participate, the **NICU General Information Questionnaire**, **BSQ**, **and CBCL**. Parents completed all questionnaires and returned the information in a provided self-addressed stamped envelope. Follow-up phone calls were made approximately 3 weeks after the packets were sent out to remind those who had not returned their completed packets. Archival data consisting of infant characteristics while hospitalized in the NICU and NICU follow-up visits at 6-, 12-, and 18-months were also used for the present study.

Table 1. Population Description at Time of NICU Stay

Variable	VLBW	Non-VLBW
N	41	29
Male/Female*	21/20	21/8
Race=Caucasian	41 (100%)	29 (100%)
Mother age at delivery 20-35	36	26
Mother age at delivery >35	5	3
Mother married	39 (95%)	27 (93%)
Private insurance	38 (3%)	28 (97%)

*Note. *p<0.05 by Chi square analysis*

Table 2. Indices of Illness Severity of Patients During NICU Stay

Variable	Percentage VLBW	Percentage Non-VLBW
GA (weeks)*	28.6	34.8
BW (gm)*	1124	2486
LOS (d)*	61.6	19.4
IMV (d)*	19.0	5.1
IVH ≥ grade3	10	11
PVL	27.5	14.8
ROP ≥ stage 3*	15.4	0
Home on monitor*	90.2	51.7

*Note. GA=gestational age; BW=birth weight; LOS=length of stay; IMV=intermittent mandatory ventilation (i.e., days on ventilator); IVH= intraventricular hemorrahage; PVL=periventricular leukomalacia; ROP= retinopathy of the premature; *p<.05.*

RESULTS

Infant characteristics in the Neonatal Intensive Care Unit

Table 2 describes factors associated with illness severity during the NICU hospitalization for the two groups. In view of the days on mechanical ventilation and average gestational age, birth weight, and length of stay for the two groups, it is clear that the VLBW infants represent a population at a statistically significantly higher risk for death and medical sequelae.

NICU Follow-up evaluations

The results of the NICU follow-up evaluations are described in Table 3. The infants were seen at approximately 6 months corrected age, 12 months corrected age, and 18 months corrected age. Following an evaluation by a physician, an occupational and physical therapist, and psychology intern (who performs a Bayley Scale of Infant Development-II [BSID-II]), a recommendation was made whether or not to refer the child for a school-based evaluation for early intervention services. For all participants, the average MDI (Mental Developmental Index) on the BSID-II was within the normal range at all three follow-up visits. However, by the third visit, a significantly greater number of the VLBW infants than the non-VLBW infants were referred for evaluation for services.

Table 3. NICU Follow-up Evaluation Results*

	VLBW (n)	Non-VLBW (N)	p
1st visit MDI PDI	88.1 (40) 78.6 (40)	89.3 (29) 83.0 (29)	NS NS
2nd visit MDI PDI	90.0 (35) 83.4 (35)	94.1 (22) 93.0 (22)	NS *
3rd visit MDI PDI	88.1 (32) 85.7 (32)	95.4 (21) 96.1 (21)	NS *
Referred for services by the completion of the 3rd visit	60.6 (20)	22.7 (5)	*

Note. MDI = Mental Development Index on the Bayley Scales of Infant Development-II, PDI = Psychomotor Index on the Bayley Scales of Infant Development-II; *p<.05, NS = non-significant.

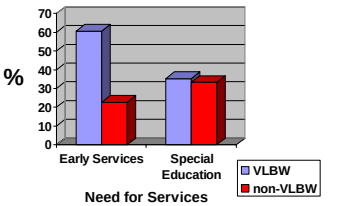

Figure 1. Percentage of VLBW and non-VLBW infants requiring early specializing services and later special education.

School age outcomes

Based on the results, children who were VLBW were more likely than children who were non-VLBW to receive a referral for early intervention services. However, children who were VLBW (35.3 %) and non-VLBW (33.3%) were indistinguishable in terms of current special education status (see Figure 1). In order to better understand the variables that predict special education services, a series of stepwise multiple regression analyses were conducted. Results revealed that the aggregate of MDI at the third visit (33.8% alone), MDI at the first visit (42.3% with MDI at third visit), and family income significantly predicted 50.3% of the variance in special education. Next, a stepwise multiple regression was conducted on the VLBW children using special education as the criterion variable. Results indicated that MDI at the third visit was the only variable that predicted special education status in school for the VLBW children (42.6%). Finally, a stepwise multiple regression analysis was conducted on the non-VLBW children to determine the significant predictors of special education status. Results revealed MDI at the first visit and family income resulted in 63.2% of the variance in special education. While these NICU graduates were more likely than children in the general population to receive special education services, it is notable that behavioral indices (BSQ and CBCL) were not in the clinically significant range. Additionally, no significant differences were revealed between children who were VLBW and non-VLBW.

Responders vs. Nonresponders

Further analyses were conducted to determine if the current sample (N=70) was representative of all eligible participants (N=331). Many families were not available for the present study because current contact information was not obtainable. T-tests were conducted between responders and nonresponders on illness severity during the NICU hospitalization (e.g., bw, ga) and NICU Follow-Up visit information (e.g., MDI and PDI on the BSID-II) Results revealed only one significant difference in periventricular leukomalacia scores (pvl), $t(307)=2.22$, $p<.05$, with nonresponders (M=1.88, SD=.333) having higher pvl scores than responders (M=1.78, SD=.42) When VLBW responders and nonresponders were compared, periventricular leukomalacia (pvl) was significantly different, $t(307)=2.22$, $p<.05$, with nonresponders having higher pvl scores (M=1.93, SD=.25) compared to responders (M=1.88, SD=.33). No significant differences were revealed between non-VLBW responders and nonresponders.

DISCUSSION

This study examined the behavioral and educational outcomes of children who required NICU services as infants. Children who were VLBW had a significantly longer and more difficult NICU course than children who were non-VLBW, as indicated by a longer time on mechanical ventilation, longer length of stay, and a higher incidence of retinopathy of the premature. Indeed, findings revealed that a significantly greater number of these VLBW as compared to the non-VLBW infants required early intervention services. Interestingly, 65% of the participants were referred for further educational services based on MDI scores on the BSID-II during follow-up visits. Nonetheless, by school age, it appears that this classification (i.e., VLBW) is no more discriminating than the NICU graduate classification is in its association with the need for special education services (see Figure 1). Additionally, contrary to previous research suggesting a greater risk for behavior problems, the results revealed that none of the behavior or temperament findings for either group were clinically or statistically significant. With approximately 35% of all high risk NICU graduates requiring educational services compared to 11% of 6- to 17-year-old children in the U.S., (U.S. Department of Education, 2001) it seems that the NICU graduate risk factor must be considered in the educational plans of these children. Given the implications of special education needs, both the medical and educational communities must be aware of such outcome information. Certainly, more research is needed to determine the specific types of school-based services that should be considered for this population.

Family income is one plausible reason for indistinguishable school-age results between children who were VLBW and non-VLBW. Low income households with impoverished environments can result in a significantly higher at-risk status for academic underachievement and behavior problems (Resnick et al., 1999; Vohr, Cashore, & Bigsby, 1999). Socioeconomic status has been hypothesized to serve as a protective factor for school and behavior problems among NICU graduates (e.g., Resnick et al., 1999; Vohr, Cashore, & Bigsby, 1999). Results revealed that the lower the MDI scores and the lower family income, the more likely the child would receive special education services in our population. Based on the demographic information provided by the families, the average family income was high (81.4% had a gross family income over $50,000), possibly serving as a protective factor for academic and behavior problems.

Analyses were conduced to determine the representative nature of the current sample with all eligible participants. Results revealed only one significant difference (pvl scores), where VLBW nonresponders and nonresponders had higher pvl scores. No other indices of illness severity while in the NICU or any follow-up data was significantly different for responders and nonresponders, providing some indication of the representativeness of the current sample. Certainly, more research is needed to determine specific aspects of early referral and intervention services and socioeconomic status that moderate the need for school-age services. Future research should also include a non-NICU comparison group when examine school-age behavioral and educational outcomes of NICU graduates.

Supported (in full or part) by Project #8188 from the Maternal and Child Health Bureau (Title V, Social Security Act), Health Resources and Services Administration, Department of Health and Human Services.