Jornal de Pediatria
ISSN: 0021-7557
assessoria@jped.com.br
Sociedade Brasileira de Pediatria
Brasil

O'Shea, T. Michael
Monitoring developmental outcome of very low birth weight infants
Jornal de Pediatria, vol. 88, núm. 6, noviembre-diciembre, 2012, pp. 452-454
Sociedade Brasileira de Pediatria
Porto Alegre, Brasil

Monitoring developmental outcome of very low birth weight infants

T. Michael O'Shea*

Fernandes et al.[1] report on the prevalence of, and risk factors for, neurodevelopmental delays in very low birth weight children. To identify delays, they used the third edition of the Bayley Scales of Infant and Toddler Development (BSID-III). Their study contributes new information because most previous research on neurodevelopmental outcomes of very low birth weight children has been based on either the first or second edition of the BSID (BSID-I and BSID-II). These earlier versions of the BSID provided assessments of cognitive functioning, referred to as the Mental Development Index (MDI) or Mental Scale; of motor function, referred to as the Psychomotor Development Index (PDI) or Motor Scale; and of the infant's behavior during the test session (Behavioral Rating Scale). Although the BSID-II MDI is not an intelligence test, a score below 70 is moderately predictive of an IQ below 70, especially among children with a neurosensory impairment.[2] The third edition of the BSID, which was used by Fernandes et al., provides an assessment of cognitive, language, motor, social-emotional and adaptive-behavioral skills. Thus, a more complete picture of the child's abilities might be available with the BSID-III.

See related article on page 471

Strengths and limitations of the study

Fernandes et al.[1] are among the first investigators to report on the performance of a very low birth weight cohort on the BSID-III social-emotional and adaptive-behavioral scales. The authors should be commended for reporting separately on each domain of development, rather than only describing a composite outcome, such as "developmental impairment." Another strength of the study is the use of multivariable analyses when identifying risk factors.

The primary limitation of the report by Fernandes et al.,[1] as acknowledged by the authors, is the relatively small sample. Another limitation is the lack of a term control group, which would provide information about the relative risk of developmental delay attributable to very low birth weight. In addition, the authors do not state whether examiners were blinded as to the medical histories of the study participants. If examiners were not blinded, biased ascertainment could have occurred due to expectations of the examiners about the detrimental effects of certain neonatal conditions, such as chronic lung disease and periventricular leukomalacia, that have been associated, in published research, with neurodevelopmental impairment.

Prevalence of neurodevelopmental delays

Fernandes et al.[1] defined developmental delays as scores less than 85, i.e., scores more than one standard deviation below the mean in the sample used to standardize the BSID-III. Studies based on the second edition of the BSID typically used a cutoff score of 70, i.e., scores more than two standard deviations below the mean. However, several investigations, including one based on a sample of Brazilian children, suggest that children score about 10 points higher on the BSID-III than on the BSID-II.[3-6] Thus, among the participants whom Fernandes et al. studied, those with BSID < 85 would probably have scored less than 75 if they had been assessed with the second edition of the BSID. It is likely then that Fernandes et al. used a

* MD, MPH. Professor of Pediatrics, Wake Forest School of Medicine, Winston Salem, North Carolina, USA.

No conflicts of interest declared concerning the publication of this editorial.

Suggested citation: O'Shea TM. Monitoring developmental outcome of very low birth weight infants. J Pediatr (Rio J). 2012;88(6):452-4. http://dx.doi.org/10.2223/JPED.2242

definition of developmental delay that is at least somewhat similar to, albeit less stringent than, that used in earlier studies in which developmental delay was defined as a BSID-II score less than 70.

Among the 58 very low birth weight children described by Fernandes et al., 6.9% had cognitive delay; 6.9%, motor delay; 29.3%, language delay; 27.6%, social-emotional delay; and 37%, adaptive-behavior delay. The rates of delay in language, social-emotional and adaptive skills are concerning, although we cannot know the extent to which these high rates are attributable to social factors, such as economic or educational disadvantage, without a comparison group of full term infants.

The median cognitive score (102) reported by Fernandes et al.[1] compares favorably with data on cohorts born in the early years of modern neonatal intensive care; in a meta-analysis of studies of children born 1960-1983, the median cognitive score (Bayley Scales or IQ test) was 96.[7] Studies of more recently born cohorts have primarily focused on extremely low birth weight (< 1,000 grams) or extremely premature (< 28 weeks gestation) newborns. In a large cohort of extremely low birth weight infants, 37% had MDI < 70, and 29% had PDI < 70.[8] In a large cohort of extremely premature infants, the rate of MDI < 70 was 26% and that of PDI < 70 was 31%.[9] The three- to four-fold higher rates observed in extremely low birth weight and extremely premature cohorts, as compared to the very low birth weight cohort described by Fernandes et al., most likely can be explained by the steep relationship of gestational age and birth weight to risk of developmental delay. The greater vulnerability of extremely low birth weight infants, as compared to very low birth weight infants, is illustrated by the difference in rates of chronic lung disease (22.4% in the very low birth weight cohort studied by Fernandes et al.,[1] as compared to 40% in a large cohort of extremely low birth weight infants)[8] and retinopathy of prematurity (25.9% in the very low birth weight cohort and 70% in the extremely low birth weight cohort).[8]

Risk factors for neurodevelopmental delays

In addition to describing the prevalence of developmental delay in a very low birth weight cohort, Fernandes et al. examined risk factors of these disorders. In most cohorts of very premature or very low birth weight infants, the most prevalent impairment at school age and beyond are cognitive impairments.[10] These impairments impact on the likelihood of academic and financial success for the individual; thus, they should be a major focus of preventive efforts and biomedical research.

Fernandes et al. found that, when adjusted for relevant confounders, chronic lung disease (also referred to as bronchopulmonary dysplasia) was associated with a decrement of 8.75 points in the BSID-III cognitive scale (slightly more than 0.5 standard deviation). Recently identified strategies to reduce the risk of chronic lung disease include vitamin A,[11] early continuous positive airway pressure with less invasive ventilation,[12] nitric oxide,[13] post-natal glucocorticoids,[14] and caffeine.[15] In two studies, interventions that reduced the risk of chronic lung disease also improved cognitive outcome: a single center study of nitric oxide,[16] and a large multi-center trial of caffeine.[17] Thus, we have evidence that research into the prevention of chronic lung disease can lead to improved long-term neurodevelopmental outcomes for preterm infants.

Periventricular leukomalacia, i.e., white matter damage, was a risk factor for delays in cognitive development, as well as delays in motor and adaptive development. This observation is consistent with the findings from studies in larger cohorts[9,18,19] and emphasizes the importance of research into the causes and prevention of cerebral white matter damage. At the present time I am aware of no evidence-based interventions to prevent white matter damage, other than that which results from large periventricular parenchymal hemorrhage. The risk of this type of hemorrhage can be reduced by treatment with prophylactic indomethacin.[20]

Consistent with many prior studies in premature infants, Fernandes et al. report that lower social class was a risk factor for cognitive delay. While social class is not readily modifiable, the effects of social disadvantage on cognitive outcome can be ameliorated by early childhood intervention services.[21] Thus, it is important that such services be provided to very low birth weight infants, particularly in the setting of socio-economic disadvantage.

Fernandes et al. found, as has been reported in other studies of premature infants,[8] that male sex was a risk factor for delays in motor development. Male sex was also associated with an increased risk of delayed language and social-emotional development. While sex is not a factor that is directly modifiable, research into the mechanism by which female sex confers protective against developmental impairment could provide insight into potential preventive strategies.

To summarize, the study by Fernandes et al. contributes to our understanding of the prevalence and potential causes of developmental delay in very low birth weight infants. The most important finding is that, among such infants, developmental delays occur frequently in multiple developmental domains. Although more study is needed of the predictive value of the BSID-III, I suggest that very low birth weight children be assessed with the BSID-III at least once during the first 2-3 years of life. Clinicians can use this information to identify children with developmental delays during infancy so that these children can be referred for rehabilitative services prior to entering school, thereby improving their chances of success in school. Researchers can use this information to identify and evaluate interventions

to improve developmental outcomes in very low birth weight and very premature infants. Those interested in continuous quality improvement can use data about long-term developmental outcomes as a measure of the impact of changes in clinical processes.

References

1. Fernandes LV, Goulart AL, dos Santos AM, Barros MC, Guerra CC, Kopelman BI. Neurodevelopmental assessment of very low birth weight preterm infants at corrected age of 18-24 months by Bayley III scales. J Pediatr (Rio J). 2012;88:471-8.
2. Hack M, Taylor HG, Drotar D, Schluchter M, Cartar L, Wilson-Costello D, et al. Poor predictive validity of the Bayley Scales of Infant Development for cognitive function of extremely low birth weight children at school age. Pediatrics. 2005;116:333-41.
3. Acton BV, Biggs WS, Creighton DE, Penner KA, Switzer HN, Thomas JH, et al. Overestimating neurodevelopment using the Bayley-III after early complex cardiac surgery. Pediatrics. 2011;128:e794-800.
4. Lowe JR, Erickson SJ, Schrader R, Duncan AF. Comparison of the Bayley II Mental Developmental Index and the Bayley III Cognitive Scale: are we measuring the same thing? Acta Paediatr. 2012;101:e55-8.
5. Moore T, Johnson S, Haider S, Hennessy E, Marlow N. Relationship between test scores using the second and third editions of the Bayley Scales in extremely preterm children. J Pediatr. 2012;160:553-8.
6. Silveira RC, Filipouski GR, Goldstein DJ, O'Shea TM, Procianoy RS. Agreement between Bayley Scales Second and Third Edition assessments of very low birth weight infants. Arch Pediatr Adolesc Med. 2012 Sep 24:1-2. [Epub ahead of print]
7. Aylward GP, Pfeiffer SI, Wright A, Verhulst SJ. Outcome studies of low birth weight infants published in the last decade: a metaanalysis. J Pediatr. 1989;115:515-20.
8. Vohr BR, Wright LL, Dusick AM, Mele L, Verter J, Steichen JJ, et al. Neurodevelopmental and functional outcomes of extremely low birth weight infants in the National Institute of Child Health and Human Development Neonatal Research Network, 1993-1994. Pediatrics. 2000;105:1216-26.
9. O'Shea TM, Kuban KC, Allred EN, Paneth N, Pagano M, Dammann O, et al. Neonatal cranial ultrasound lesions and developmental delays at 2 years of age among extremely low gestational age children. Pediatrics. 2008;122:e662-9.
10. Johnson S, Fawke J, Hennessy E, Rowell V, Thomas S, Wolke D, et al. Neurodevelopmental disability through 11 years of age in children born before 26 weeks of gestation. Pediatrics. 2009;124:e249-57.
11. Tyson JE, Wright LL, Oh W, Kennedy KA, Mele L, Ehrenkranz RA, et al. Vitamin A supplementation for extremely-low-birth-weight infants. National Institute of Child Health and Human Development Neonatal Research Network. N Engl J Med. 1999;340:1962-8.
12. SUPPORT Study Group of the Eunice Kennedy Shriver NICHD Neonatal Research Network, Finer NN, Carlo WA, Walsh MC, Rich W, Gantz MG, et al. Early CPAP versus surfactant in extremely preterm infants. N Engl J Med. 2010;362:1970-9.
13. Askie LM, Ballard RA, Cutter G, Dani C, Elbourne D, Field D, et al. Inhaled nitric oxide in preterm infants: a systematic review and individual patient data meta-analysis. BMC Pediatr. 2010;10:15.
14. Doyle LW, Halliday HL, Ehrenkranz RA, Davis PG, Sinclair JC. Impact of postnatal systemic corticosteroids on mortality and cerebral palsy in preterm infants: effect modification by risk for chronic lung disease. Pediatrics. 2005;115:655-61.
15. Schmidt B, Roberts RS, Davis P, Doyle LW, Barrington KJ, Ohlsson A, et al. Caffeine therapy for apnea of prematurity. N Engl J Med. 2006;354:2112-21.
16. Mestan KK, Marks JD, Hecox K, Huo D, Schreiber MD. Neurodevelopmental outcomes of premature infants treated with inhaled nitric oxide. N Engl J Med. 2005;353:23-32.
17. Schmidt B, Roberts RS, Davis P, Doyle LW, Barrington KJ, Ohlsson A, et al. Long-term effects of caffeine therapy for apnea of prematurity. N Engl J Med. 2007;357:1893-902.
18. Kuban KC, Allred EN, O'Shea TM, Paneth N, Pagano M, Dammann O, et al. Cranial ultrasound lesions in the NICU predict cerebral palsy at age 2 years in children born at extremely low gestational age. J Child Neurol. 2009;24:63-72.
19. De Vries LS, Van Haastert IL, Rademaker KJ, Koopman C, Groenendaal F. Ultrasound abnormalities preceding cerebral palsy in high-risk preterm infants. J Pediatr. 2004;144:815-20.
20. Ment LR, Oh W, Ehrenkranz RA, Philip AG, Vohr B, Allan W, et al. Low-dose indomethacin and prevention of intraventricular hemorrhage: a multicenter randomized trial. Pediatrics. 1994;93:543-50.
21. Spittle AJ, Orton J, Doyle LW, Boyd R. Early developmental intervention programs post hospital discharge to prevent motor and cognitive impairments in preterm infants. Cochrane Database Syst Rev. 2007;(2):CD005495.

Correspondence:
T. Michael O'Shea
Wake Forest School of Medicine, Winston Salem
North Carolina - USA
Tel.: +1 (336) 716.4663
Fax: +1 (336) 716.2525
E-mail: moshea@wfubmc.edu