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Neuropsychological Evaluation of High-Risk Children from Birth to Seven Years of Age

Judith Nogueira Cruz[1], Carolina Laynez Rubio[2],
Francisco Cruz Quintana[1], and Miguel Perez Garcia[1]

[1]Universidad de Granada (Spain)
[2]Hospital Universitario San Cecilio (Spain)

High Risk Children (HRC) are those with an increased risk of abnormal development due to any factor affecting neurological growth. Those factors have been the focus of most studies in this area. However, little is known about their long-term consequences over the course of child development. Objectives: the goal was to study the cognitive, emotional and academic outcomes of 7-year-old children diagnosed as HRC at birth. Method: We compared 14 HRC and 20 healthy children using the WISC-IV, BASC and Brunet-Lezine tests. Results: HRC showed cognitive, emotional and academic deficits compared with healthy children. However, Brunet-Lezine scores obtained over the course of development (6, 12, 18 and 24 months) were not predictive of the children's' current psychological status. Conclusions: long-term follow-up with HRC should be maintained until 7 years of age, at which point an appropriate treatment should be implemented.
Keywords: cognitive, emotional, academic and behavioral assessment, high-risk children, follow-up.

Los niños de alto riesgo (NAR) tienen un mayor riesgo de desarrollo anormal debido a factores relacionados con el crecimiento neurológico. Aunque se han investigado la influencia de muchos de estos factores, se conoce muy poco sobre su efecto a largo plazo en el desarrollo del niño. Objetivo: el objetivo fue investigar el estado cognitivo, emocional y académico de niños de 7 años diagnosticados como NAR en el momento del nacimiento. Metodología: Se compararon 14 niños diagnosticados como NAR con 20 niños sanos en los tests WISC-IV, el BASC y el Brunet-Lezine. Resultados: Los niños NAR mostraron deterioro cognitivo, emocional y académico comparados con los niños sanos. Por otro lado, las puntuaciones del Brunet-Lezine obtenidas a los 6, 12, 18 y 24 meses no fueron predictivas del estado psicológico de los niños a los 7 años. Conclusiones: el seguimiento a niños diagnosticados con NAR debería mantenerse, al menos, hasta los 7 años y deberían recibir un tratamiento adecuado.
Palabras clave: evaluación cognitiva, emocional, académica, niños de alto riesgo, seguimiento.

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Correspondence concerning this article should be addressed to Francisco Cruz Quintana. Dpto. de Personalidad, Evaluación y Tratamiento Psicológico, Facultad de Psicología. 18071 Granada (Spain) Fax: +34-958243749. E-mail: fcruz@ugr.es

Children labeled high-risk are those that, due to pre, peri or postnatal antecedents, have a higher probability of presenting with either transitory or permanent alterations during development. Specifically, these alterations have to do with adverse situations in the socio-familial sphere and/or certain genetic and biological predispositions, such as intrauterine infections, premature birth, neonatal interventions, the occurrence and severity of peri or neonatal illnesses, malformations, hypoxia, cerebral hemorrhages and postnatal infections (Grupo de Atención Temprana [GAT], 2000; Kumar et al., 2008).

The number of at-risk births seems to increase with each year, first and foremost those involving babies born before the 37th week of gestation, and those with asphyxia; Hamilton, Martin & Ventura, 2006; Revage et al., 2008). At-risk birth may be associated with complications in central nervous system development, and with permanent lesions that make for a higher risk and frequency of intracranial hemorrhages, which for premature babies are associated with organic immaturity and consequently, difficulty regulating arterial pressure (Roze et al., 2009. The more immature a child's brain is, the more vulnerable it is to possible lesions, bearing consequences that may stay with him or her for the rest of their life (de Haan & Johnson 2003; Johnston, 2009; Stiles, 2008).

Recent research on children who are high-risk from birth indicates that though at the time of hospitalization, they appear to have achieved normal development, close to half later present with delayed cognitive abilities compared to children of the same age up to six years of age (Delobel-Ayoub et al., 2009 Johnson et al., 2009; Pharoah, Stevenson, & West, 2003). Survivors of premature birth experience a greater number of medical afflictions and a greater number of neuromotor, neurocognitive and behavioral problems (Aylward, 2005; Ashton, Lawrence, Adams, & Fleischman, 2009; Boardman et al., 2010; Ricci et al., 2008; Skrablin, Maurac, Banovic, & Bosnjak-Nadj, 2009; Tyson & Saigal, 2005), and these problems have been observed across the spectrum of premature babies (Johnson et al., 2009). Within the literature, we found studies relating prematurity to developmental disorders, hyperactivity and attention deficit disorders, and difficulty efficiently acquiring academic knowledge, all of which may interfere with the child's academic and social integration (Begega et al., 2010; Böhm, Lundequist, & Smedler, 2010). We also found studies relating low birth weight to low academic achievement, emotional and behavioral problems, language difficulties and deficits in executive functioning (Roze et al., 2009; Luu et al., 2009; Johnson et al., 2009).

Assessing the consequences for high-risk children is made possible by progressive follow-up programs during the first years of life. These programs are very useful because of their ability to support families, and their early detection of any consequences that could affect, particularly, the central nervous system (Johnston, 2009; Martín Iriondo, Poó, & Ibañez, 2006). This is not the situation for everyone, however (Arce et al., 2003; Ruiz Extremera & Robles Vizcaíno, 2004). Babies born with high risk need to maintain regular follow-up assessments to determine their growth, any consequences on neurodevelopment, to facilitate early detection of delayed or atypical development, and so as to plan an intervention as early as possible (Baron & Rey-Casserly, 2010; Ruiz Extremera & Robles Vizcaíno, 2004). High-risk children who participate in follow-up and intervention programs have been shown to achieve higher developmental levels, and to exhibit fewer behavioral problems and less difficulty adapting socially than those who develop unmonitored. These programs' benefits, therefore, are clear and enormously valuable to these kids' social integration (Butler et al., 2008; Kumar et al., 2008; Maguire et al., 2009; McCornick et al., 2006).

Early follow-up, detection and intervention are demonstrated to be essential to improving the situation for children born at-risk and their families, yet we remain in the dark about precisely how these variables act. Developmental studies of high-risk children are indispensable to determining, among other things, the efficacy of treatments at influencing later development, whether or not minor dysfunction during the early years of one's life may be indicative of neuropsychological dysfunction later on, whether or not differential courses of development occur as a function of risk factors and finally, whether or not new diagnostic methods could allow for earlier detection of problems, in turn allowing for earlier intervention to resolve or at least mitigate future problems (Baron & Rey-Casserly, 2010).

Considering the above, the present study proposes two objectives: The first was to complete cognitive, emotional, behavioral and academic assessments of a sample of 7-year-old boys and girls who were born high-risk in the year 1999 at Hospital Universitario San Cecilio in Granada, and who were evaluated using the Brunet-Lézine psychomotor development test at 6, 12, 18 and 24 months-old at the Early Follow-up and Stimulation Unit. The second object we proposed was to determine whether or not the assessments completed using the Brunet-Lézine psychomotor development test predicted cognitive, emotional, behavioral and academic alterations at age 7.

Method

Participants

Thirty four people participated, 14 belonging to the High Risk group of children and 20 to the control group. The High Risk group was comprised of 8 boys and 6 girls with an average age of 97 months (*SD* = 4.64) and of them, 10 were in second grade, 3 were in third and 1 was in first grade, all in elementary school. All participants were randomly selected, and were high-risk boys and girls born between September, 1998 and the end of 1999. When they were brought to the Early Follow-up and Stimulation Unit at Hospital Universitario San Cecilio, they presented with the following diagnoses: 6 were premature, 1 had periventricular leukomalacia, 1 had intrauterine growth restriction at birth, 2 had psychomotor developmental delay, 1 had had an episode of sudden death, then was resuscitated, 1 had convulsions, 1 had metabolic alterations and 1, respiratory distress. Table 1 displays a description of the sample's clinical characteristics.

The control group was comprised of 8 boys and 12 girls, controlling for age and grade in school. They had an average age of 94 months (*SD* = 4.08), and were taken from a second grade class at Tinar Public Kindergarden and Elementary School in Albolote, Granada, constituting a random sample. In all cases, the teachers responsible for the children signed an informed consent form prior to their participation in the study.

Table 1
Clinical Data for the High-risk Group

Variables	Mean	Standard Deviation	*n* (%)
Gestational age	36.07	4.14	
Weight in grams	2537.50	922.15	
Size in cm	46.12	5.36	
Head perimeter cm	32.33	4.32	
Thoracic perimeter cm	30	5.26	
Apgar 1 minute	6	2.12	
Apgar 5 minutes	8	1.90	
Time admitted in days	14	8.29	
Type of birth			
Normal			5 (38.5)
Caesarean			8 (61.5)
Neurological assessment			
Normal			2 (18.2)
Slight			8 (72.7)
Moderate			1 (9.1)
Severe			0 (0)
Profound			0 (0)
Original diagnosis			
Prematurity			6 (42.9)
Periventricular Leukomalacia			1 (7.1)
IGR			1 (7.1)
Psychomotor delay			2 (14.3)
Episode of sudden death			1 (7.1)
Metabolic irregularity			1 (7.1)
Respiratory distress			1 (7.1)
Convulsions			1 (7.1)
Diagnosis when admitted			6 (42.9)
Prematurity			1 (7.1)
Periventricular Leukomalacia			2 (14.3)
Delayed maturation			2 (14.3)
Tonal alteration			2 (14.3)
Episode of sudden death			1 (7.1)
Metabolic irregularity			1 (7.1)
Convulsions			1 (7.1)

Instruments

WISC-IV, Wechsler Intelligence Scale for Children - IV.

This is an updated, revised version of the previous Wechsler scales for children (WISC, WISC-R and WISC-III). It provides information about the child's overall intellectual capacity (IC Total) and about his or her functioning in the main areas of intelligence (verbal comprehension, perceptual reasoning, working memory and processing speed). The scale includes 15 subtests, 10 primary and 5 optional. This instrument's main structural changes from previous versions were that it incorporated 5 newly created tests (animals, riddles, word searches, picture concepts, and letters and numbers) and eliminated others that were part of earlier versions (mazes, brain-teasers and short stories). All materials have been updated, subtests' content has been revised and adapted to current needs as well as the latest advances in research, broadening its applications to include children with very low or high capacities, and the norms for application and grading were improved upon. The WISC-IV was standardized using a representative sample of 1,590 Spanish children (Wechsler, 2010). Age barometers were used to distribute participants into 33 different age groups, each 4 months apart.

BASC, Behavioral Assessment System for Children and Adolescents.

The BASC is a set of instruments that enables one to assess the adaptive and maladaptive aspects of children's and adolescents' behavior. It offers the possibility of collecting this information from parents and teachers (P scales and T scales) as well as from the subject him or herself (S scales). In addition to these sources of information, it includes a system for observing the subject (O) and a format for collecting his or her clinical history (H). These instruments can be used all together or separately. In the present study, we only collected information from the parents (P scales) and included evaluations of these positive aspects: leadership, social skills (the abilities needed to effectively interact with peers and adults at home, school and in the community), and adaptability (the ability to adapt to environmental changes). We also included negative aspects: atypicality (the tendency to behave in an immature, 'strange' way), which is commonly associated with psychosis (visual or auditory hallucinations, for example), anxiety (the tendency to be nervous, fearful and worried about real or imaginary problems), aggression (the tendency to act hostile [verbally or physically] and threatening to others), attentional difficulties (the tendency to become easily distracted and the ability to concentrate only momentarily), hyperactivity (the tendency to be excessively active, often precipitated by working or doing activities, and acting without thought), withdrawal (the tendency to avoid others and reject all social contact), externalized problems, internalized problems, depression (feelings of unhappiness, sadness and stress that can result in an inability to participate in everyday activities (neurovegetative symptoms or suicidal thoughts), behavioral problems (a tendency toward antisocial behavior, rule-breaking, even to the extent of destroying private property), somatization (the tendency to be overly sensitive and complain about minor physical pains). It also includes validity and control scales. The version released by TEA Editions was used (Reynolds, 2004)

Brunet-Lézine psychomotor development test.

This scale is used to measure psychomotor development during early childhood. It is appropriate for children between the ages of 0 and 30 months and includes complementary tests up to six years of age: one applicable from 24-months-old to 5-years-old, and another for levels corresponding to 3, 4, 5 and 6 years of age with fewer verbal tests. It assesses the child's development in four areas: posture control and motoricity; hand-eye coordination and adapting to objects behavior; language; and sociability, or personal and social relations. The scale is comprised of two parts: one experiential, in which the tests are directly administered to the child, and another in which the child is observed behaving in his or her everyday life; that information is collected by asking the parents questions. Using the scale, a Developmental Age (DE) and Developmental Quotient (DQ) were obtained for each area, as well as a total score combining all areas. The version offered by TEA Editions was utilized. (Josse, 1998).

Procedure

The procedure followed throughout the study differed for the clinical versus control groups. In the case of the clinical group, the children were randomly selected from the database of the Early Follow-up and Stimulation Unit at Hospital Universitario San Cecilio from among all the high-risk children who received neo and postnatal care there. Furthermore, all were born between September 1, 1998 and the end of 1999 and had been administered the Brunet-Lézine psychomotor development test at 6, 12, 18 and 24 months of age.

After completing the selection, a letter was sent to each child's parents, providing them with information about the research we planned to conduct, and requesting their cooperation and their child's participation. Later, the parents were contacted via telephone to ask whether or not they had received the letter, to again provide them with information about the research, resolving any doubts they may have had, and to schedule an appointment with their child on a convenient date for them. Once they accepted, an appointment with each child was scheduled for a different day, to take place at the facilities of the Early Follow-up and Stimulation Unit of Pediatric Services at Hospital Universitario San Cecilio in Granada, where the children were evaluated. Prior to completing the evaluation, we went on to clear up any doubts and to again explain to the parents the nature of the research we were conducting.

While their children were assessed in one of the Unit's offices, parents responded to the questions on the BASC in another office after receiving instructions. The assessment lasted approximately 2 to 3 hours in total, including breaks. The number of breaks ranged from 1 to 3, depending on the children's needs. Assessments were always conducted in a single session, and then once the children's school year was over, their parents were contacted to find out how they had performed academically. Finally, all participants' parents were given a detailed clinical report with the results of our completed evaluation, as well as information about therapy for their children.

As for the control group, first, we got in touch with board of directors at the Tinar de Albolote Public Pre and Elementary School in Granada. We explained the nature of the research we were conducting and requested their cooperation. After they agreed to participate, we contacted the teacher of the class that was going to collaborate, who then explained our presence in the classroom to her students. On the agreed upon dates, we arrived at the children's classroom and called them up one by one according to their location in the room, left to right and front to back. This assessment was performed in the teachers' lounge and in the office of the director of the school when available. When this evaluation was over, the children returned to their classrooms. No assessments were performed on Mondays and Wednesdays because it would have conflicted with classroom activities. Last, the teacher was given a report on each child's results.

Variables and Statistical Analyses

This study's independent variable was which group participants belonged to: high-risk children and control group children. The cognitive dependent variable was students' rise in score on the subtests of the WISC-IV, the emotional and behavioral dependent variables were T scores on the subscales of the BASC, and the academic dependent variables were number of classes failed, special education needs and whether or not the child repeated a grade. Additionally, we took the total Developmental Quotient on the Brunet-Lézine psychomotor development test at 12-months-old from each child's clinical history. Total IQ was used as a combined measure of Mental IQ and Psychomotor IQ so as to reduce the number of statistical analyses needed. We utilized Student's *t* analysis for independent samples to detect any possible between-groups differences. To determine the predictive capacity of the Brunet-Lézine psychomotor development test, we used linear regression analysis. In all statistical analyses, the Bonferroni correction for statistical significance was applied. In the case of the WISC-IV, the significance was corrected to .002 and for the BASC, it was corrected to .003.

Results

First of all, we tested whether or not the groups were equal in terms of age and education. To do so, we performed a Student's *t* analysis for independent samples, the group variable (high risk children vs. control group children) being the independent variable and age the dependent variable. The results revealed no statistically significant differences.

Current Psychological State of the At-risk Group

Second, we investigated the children's cognitive development using the WISC-IV. To do so, 20 *Student t* analyses for independent samples were done, the group variable (high risk vs. control group children) serving as the independent variable and rise in scores on the subtests/indices of the WISC-IV as dependent variables. The results showed statistically significant differences (after the Bonferroni correction) on the similarities subtest, digit span subtest, picture concepts subtest, vocabulary subtest, letter-number sequencing subtest, comprehension subtest, symbol-search subtest, picture completion subtest, arithmetic subtest, verbal comprehension index, perceptual reasoning index, working memory index, processing speed index and total intellectual quotient index. In all cases, the high-risk group scored lower than the control group. On the remaining subtests, no statistically significant differences were found (see Table 2). Cohen's "d" was calculated for the analyses performed. The results indicate a mean of 1.31 (*SD* = 0.43), with values ranging from 0.53 to 1.97 (see Table 2).

Third, we went on to study the children's behavioral and emotional development using the BASC. In order to complete this step, 15 *Student t* analyses for independent samples were done such that the group variable (high-risk children vs. control group children) was the independent variable and T scores on the subtests of the BASC were the dependent variables. The results revealed statistically significant differences (after applying the Bonferroni correction) for the hyperactivity subtest, the behavioral problems subtest, the attentional problems subtest, the atypicality subtest, the social skills subtest, the leadership subtest, the externalizing problems subtest, and the adaptive skills subtest. Cohen's "d") was calculated in each analysis. The results indicated a mean of 1.05 (*SD* = 0.45), with values ranging from 0.05 to 1.67 (see Table 3).

Table 2
Mean, Standard Deviation, Significance and Cohen's "d" for the Score Increases on the Subtests and Indices of the WISC-IV for the Two Groups

Subtests/indices	Pathological Group (Mean ± *SD*)	Control Group (Mean ± *SD*)	*t*	*p*	*d*
BLOCKS	7.00 ± 3.55	9.65 ± 2.87	–2.40	0.022	0.82
SIMILARITIES	5.71 ± 3.05	10.10 ± 3.57	–3.74	0.001	1.33
DIGITS	7.14 ± 3.72	11.25 ± 2.92	–3.61	0.001	1.24
PIC. CONCEPTS	8.28 ± 4.63	12.60 ± 2.32	–3.58	0.001	1.24
CODES	7.57 ± 3.67	10.50 ± 2.04	–2.98	0.005	1.03
VOCABULARY	5.50 ± 3.00	11.40 ± 3.15	–5.47	0.000	1.92
LETTERS & NUM	7.36 ± 3.32	11.90 ± 4.17	–3.39	0.002	1.21
MATRICES	6.64 ± 2.56	10.35 ± 3.66	–3.26	0.003	1.19
COMPREHENSION	5.21 ± 2.58	10.85 ± 3.34	–5.29	0.001	1.90
SYMBOL SEARCH	7.35 ± 3.32	11.45 ± 2.54	–4.07	0.001	1.40
PIC. COMPLETION	6.71 ± 3.65	10.45 ± 2.39	–3.61	0.001	1.24
ANIMALS	8.57 ± 4.45	10.60 ± 2.80	–1.63	0.112	0.56
INFORMATION	6.85 ± 3.25	9.75 ± 2.75	–2.80	0.009	0.97
ARITHMETIC	7.43 ± 4.16	11.70 ± 2.96	–3.50	0.001	1.20
REASONING	8.00 ± 3.98	9.80 ± 2.84	–1.54	0.133	0.53
VC	16.64 ± 7.15	32.35 ± 8.78	–5.52	0.001	1.97
PR	21.93 ± 9.28	32.60 ± 6.95	–3.84	0.001	1.93
WM	14.28 ± 6.68	23.15 ± 5.84	–4.10	0.001	1.42
PS	14.86 ± 6.50	22.00 ± 3.92	–4.00	0.001	1.37
IQ_T	67.71 ± 25.69	110.10 ± 19.14	–5.52	0.001	1.90

Note: VC = verbal comprehension; PR = perceptual reasoning; WM = working memory; PS = processing speed; IQ_T = total intellectual quotient.

Table 3
Mean, Standard Deviation, Significance and Cohen's "d" for T Scores on the Subtests and Indices of the BASC for the Two Groups

Subtests/indices	Pathological Group (Mean ± *SD*)	Control Group (Mean ± *SD*)	*t*	*p*	*d*
Aggression	57.21 ± 16.72	45.95 ± 10.67	2.40	0.02	0.82
Hyperactivity	60.14 ± 17.39	44.20 ± 7.44	3.67	0.001	1.28
Behavioral Problems	67.07 ± 14.58	49.80 ± 8.59	4.34	0.001	1.54
Attentional Problems	64.57 ± 12.33	44.70 ± 11.49	4.82	0.001	1.67
Atypicality	54.36 ± 10.47	44.20 ± 5.95	3.60	0.001	1.24
Depression	56.50 ± 13.05	46.05 ± 7.93	2.90	0.007	1.00
Anxiety	50.93 ± 8.25	51.30 ± 6.61	–0.146	0.88	0.05
Withdrawal	49.93 ± 13.53	43.75 ± 5.62	1.84	0.075	0.65
Somatization	47.28 ± 13.26	42.65 ± 6.49	1.35	0.185	0.47
Adaptability	47.71 ± 10.90	56.10 ± 7.19	–2.71	0.011	0.93
SS	45.07 ± 9.78	56.35 ± 9.59	–3.35	0.002	1.16
Leadership	44.57 ± 6.98	55.00 ± 8.10	–3.90	0.001	1.38
Externalizing Prob.s	63.57 ± 17.03	45.75 ± 9.00	3.97	0.001	1.37
Internalizing Prob.s	53.21 ± 13.26	46.50 ± 5.85	2.01	0.05	0.70
Adaptive Skills	45.28 ± 7.56	57.25 ± 8.05	–4.37	0.001	1.53

Note: SS = Social Skills; Prob.s = Problems

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Fourth, we proceeded to study the academic achievement of the groups, taking into consideration the number of classes they failed, whether or not they repeated grades, and whether or not they required special education resources. The results showed that children in the at-risk group repeated grades more frequently (n = 3; 21.4%), failed more classes (n = 8; 57.1%) and required more special education support (n = 12; 85.7%). No child in the control group had to repeat a grade, failed a class or had special education needs.

Predictive Capacity of the Brunet Lézine Psychomotor Development Test.

Finally, we analyzed the ability of the Brunet-Lézine psychomotor development test, administered at 12 months of age, to predict participants' current cognitive, emotional and behavioral states (at seven years-old). For the WISC-IV, 20 simple linear regression analyses were applied, using total psychomotor quotient from the Brunet-Lézine test at 12 months of age as the predictor, and the subtests and indices of the WISC-IV as dependent variables. The results indicate there was no relationship in any of the analyses performed. As for the BASC, 15 simple linear regression analyses were done taking total Developmental Quotient on the Brunet-Lézine psychomotor test at 12 months of age as the predictor, and the subtests of the BASC as dependent variables. The results indicate that one's score on the Brunet-Lézine test was a significant predictor of his or her outcome on the Social Skills subtest [$F(1) = 6.62$; $p < .02$], where $R = 0.602$. No significant relationship was observed between the remaining variables.

Discussion

One of the objectives of this study was to carry out a cognitive, emotional, behavioral and academic assessment of a sample of 7-year-old boys and girls born at high risk, and to follow-up with them, but not provide any specific or ongoing treatment. The results gleaned from this assessment indicate this population of interest has lower total IQ scores than the control group, and is developmentally delayed in all areas of the WISC, especially when it comes to verbal comprehension and perceptual reasoning. It is still uncertain whether or not risk factors such as prematurity affect overall cognitive functioning, or specific abilities more (Hoff, Hansen, Gresien, & Mortensen, 2006; Bayless & Stevenson, 2007). Our results are in line with those of other studies that have found at-risk and high-risk children to have lower IQs. Such is the case, for example, for children born premature or highly premature (Narberhaus et al., 2007; Kumar et al., 2008) and those who present with periventricular hemorrhages or preventricular leukomalacia (Baron, Ahronovich, Erickson, Gidley-Larson, & Litman, 2009; Wilson-Costello et al., 2007), compared to children who had full-term births, even when they exhibit adequate IQ scores. Measures of intelligence have been used as indicators of subsequent difficulties when formal schooling begins, and it has been suggested that these difficulties persist into adolescence (Beguega et al., 2010). At seven years of age, the children in our study presented with altered functioning in various main areas of intelligence (Verbal Comprehension, Perceptual Reasoning, Working Memory and Processing Speed). Studies of children born pre-term indicate, first of all, that problems with language, writing, reading and arithmetic are more common among school-age children born pre-term than full-term (Wocadlo & Rieger, 2007). Furthermore, they suggest a relationship between cognitive abilities and birth weight. As birth weight decreases, the need to use special education services increases, scores on standardized intelligence tests are poorer than those of children born full-term, and there is a higher probability of experiencing behavioral problems and requiring special classes or classes outside of school (Neubauer, Voss, & Kattner, 2008). While the majority of studies have compared children with very low birth weight (<1,500 g) to those born full-term, so far, studies of moderately low-weight children (1,500-2,499 g) have found they exhibit the same alterations in learning and disorders in attention, memory and behavior, among other things (Bayless, Pit-ten Cate, & Stevenson, 2008; Morse, Zheng, Tang, & Roth, 2009; Pritchard et al., 2009).

With regards to the language deficiencies reflected in our results, studies within the body of literature have demonstrated premature children with low birth weights to have a high risk of experiencing difficulties with speech, and expressive and receptive language until school-age, especially morphosyntax and nomination, as well as difficulties reading and writing and learning disorders (Allen, 2008; Baron et al., 2009; Charkaluk, Truffert, Fily, Ancel, & Pierrat, 2010; McCornick et al., 2006 Ortiz-Mantilla, Choudhury, Leevers, & Benasich, 2008). Our results indicate the at-risk group had difficulties with vocabulary, comprehension, concepts, and symbol search. It is also suggested within the literature that in addition to having more difficulties and delayed experiences in language acquisition, at-risk children have a higher probability of experiencing long-term language disorders. By the same token, detecting the early signs of language difficulty has been prioritized so as to prevent disorders from becoming inculcated as much as possible (Sansavini et al., 2010).

Regarding the children evaluated in the present study, we would like to emphasize that the majority, 72.7% to be specific, were deemed to have slight neurological problems in their clinical histories. Both delayed neuromotor development, or abnormality in this development from an early age, and slight neurological disorders, have been found to be associated with learning and behavioral problems for school-age children (Denckla, 2005; Eichenwald & Stark, 2008; Gidley Larson et al., 2011). On a related note, one of the most common abnormalities observed in children born premature is lesions in the brain's white matter. Meanwhile, reducing the volume of white matter seems to

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affect the cerebral regions related to processing language, writing and emotional behavior, such as the temporal lobe (Begega et al., 2010; Jenkins, Chang, & Singh, 2009; Patra, Wilson-Costello, Taylor, Mercuri-Minich, & Hack, 2006).

With respect to our emotional and behavioral assessment, the results also reveal the presence of attentional and behavioral problems, hyperactivity, deficits in adaptive and social skills, low capacity for leadership, and emotional symptoms in the population studied. These results support the findings of other authors in positing a relationship between behavioral problems and cognitive deterioration. Delobel-Ayoub et al. (2009) found in their study that at-risk children exhibit significantly more behavioral problems, and a prevalence of hyperactivity, attention deficit and emotional symptoms twice that of children born full-term. It is also important to note that behavioral problems are associated with cognitive deterioration. We agree with these authors in favoring early detection of behavioral problems in at-risk and high-risk children, both with and without cognitive deterioration. This is especially pertinent considering that follow-up studies in adolescents have demonstrated an increased risk of attention deficit, hyperactivity and depression at that age (Indredavik et al., 2010; Saigal, Pinelli, Hoult, Kim, & Boyle, 2003). In the present study, information provided by the parents suggests that at-risk children, as compared to the control group, externalize more problems and tend to behave immaturely.

As for the academic results, our data reveal a clear inequality between children born high-risk and children in the control group. These data are indicative of problems adjusting academically and are consistent with the findings of other follow-up studies that have shown that at-risk children, compared to those born full-term, have considerable educational needs, experience more problems adapting academically, more often repeat grades, and require more special education support at the ages of 6 and 7 years-old. These situations are inversely related with gestational age at birth and the children's age upon assessment, among other factors (Marret et al., 2009).

In addition, as a second objective, we sought to determine whether or not the measures taken by the Brunet-Lézine psychomotor development test 7 years ago could predict current cognitive, emotional, behavioral and academic alterations. We found that psychomotor development scores based on the Brunet-Lézine test at the age of 12 months only predicted a deficit in social skills. It is worth mentioning that this psychomotor development test has a specific scale that measures sociability as well as social and personal relationships.

Our data have demonstrated that the BL at 12 months does not have the capacity to predict the cognitive or emotional state of 7-year-old children. The Brunet-Lézine test has been employed during the first two years of life in many studies of at-risk children (Charkaluk et al., 2010; Fily, Pierrat, Delporte, Breart, & Truffert, 2006; Zampini & D'Odorico, 2009). Our data echo the findings of prior studies in expressing doubts about its efficacy and in considering it a rudimentary test. If pathological scores persist, that would indicate a need to use more specific tests (Ruiz Extremera, et al., 2001). Therefore, it would be inappropriate to register every child for follow-up who scores low or ambiguously on the test despite their having achieved normalcy (Geva, Eshel, Leitner, Valevski, & Harel, 2006). On a related note, children with adverse results should be evaluated by means of more specific tests and the content of interventions should not be restricted to psychomotor neurorehabilitation alone. It should also include verbal, numerical and memory development abilities (Baron & Rey-Casserly, 2010).

In light of these results, from our point of view it is essential to first off, find and review existing protocols to treat these problems as they arise at school. Toward that end, we believe current studies of school children born at-risk are absolutely crucial. We would like to emphasize the clinical implications of this research, especially the importance of early detection and intervention, as well as follow-up with high-risk children, the importance of applying more precise tools from an early age in order to bring the problem into focus with greater exactitude, thereby allowing for more effective intervention, avoiding more severe future dysfunction, and mitigating the tremendous impact that high-risk factors have on children and their families in terms of mental development. That being said, our results may be limited by the small sample size of the group of at-risk children. That being said, we do not believe this limitation to have substantially affected our data, considering the effect sizes found were very high.

In conclusion, this study conveys that at seven years of age, participating children born with high risk present with alterations in various main areas of intelligence, exhibit numerous problems in behavioral and emotional development, and in addition, they all have academic achievement problems and special education needs. Finally, the Brunet-Lezine administered at 12 months did not predict any of the findings above.

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