Cognitive and behavioral screening of children with learning disabilities: a preliminary study

Triagem cognitiva e comportamental de crianças com dificuldades de aprendizagem escolar: um estudo preliminar

Selección cognitiva y conductual de niños con dificultades de aprendizaje escolar: un estudio preliminar

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ABSTRACT

Objective: To evaluate the applicability of the Mini-Mental State Examination (MMSE) and the Pediatric Symptom Checklist (PSC) as a screening test for cognitive and psychosocial problems in children with learning disabilities.

Methods: Descriptive and cross-sectional study involving 103 children aged 6 to 9 years, with possible learning disabilities, referred from a public school in Curitiba, Brazil, from March 1, 2002 to June 30, 2009. Data were simultaneously collected by a multidisciplinary team using the PSC, MMSE, and Wechsler Intelligence Scale for Children (WISC-III). From 2007 on the Child Behavior Checklist (CBCL) and Teacher's Report Form (TRF) were used and compared with the PSC. Correlation coefficients between the tests were calculated, with the significance level set at $p<0.05$.

Results: Among the studied children, 10% had some type of learning disability, 76% were male, and 24% were female. The most prevalent age group was 6 to 7 years. A positive family history was found in 45% of cases, and an adverse obstetric history in 18%, with low birth weight the most common issue. Correlations were detected between the MMSE and WISC-III ($r=0.73$) and between the CBCL and PSC ($r=0.53$).

Conclusion: The MMSE and PSC can be used by pediatricians as screening tools for detection of cognitive and psychosocial problems in children with learning disabilities.

Key-words: learning; learning disabilities; screening.

RESUMO

Objetivo: Avaliar a aplicabilidade do *Mini-Mental State Examination* (MMSE) e da lista de sintomas pediátricos (LSP) como teste de triagem cognitiva e de problemas psicossociais em crianças com dificuldades de aprendizagem.

Métodos: Estudo descritivo e transversal envolvendo 103 crianças entre seis e nove anos de uma escola pública de Curitiba (PR) com prováveis dificuldades de aprendizagem, realizado de 1º de março de 2002 a 30 de junho de 2009. Os dados foram obtidos simultaneamente por uma equipe multidisciplinar na avaliação inicial, com a aplicação do MMSE, da LSP e do *Wechsler Intelligence Scale for Children* (WISC III). Após 2007 o *Child Behavior Checklist* (CBCL) e o *Teacher's Report Form* (TRF) foram utilizados, sendo também comparados à LSP. Os coeficientes de correlação entre os testes foram calculados, sendo significante $p<0,05$.

Resultados: Das crianças analisadas, 10% apresentavam algum tipo de dificuldade de aprendizagem, sendo 76% do sexo masculino e 24% do feminino. A faixa etária mais prevalente foi

entre seis e sete anos de idade. História familiar positiva ocorreu em 45% dos casos e antecedentes obstétricos em 18%, sendo o baixo peso o mais frequente. O escore do MMSE mostrou correlação com o do WISC III (r=0,73) e o CBCL mostrou moderada correlação com o LSP (r=0,53).

Conclusões: O MMSE e a LSP podem ser utilizados pelo pediatra como triagem cognitiva e de problemas psicossociais em crianças com dificuldade de aprendizagem.

Palavras-chave: aprendizagem; transtornos de aprendizagem; triagem.

RESUMEN

Objetivo: Evaluar la aplicabilidad del *mini-mental state examination* (MMSE) y de la lista de síntomas pediátricos (LSP) como prueba de selección cognitiva y de problemas psicosociales en niños con dificultades de aprendizaje.

Métodos: Estudio descriptivo y transversal implicando a 103 niños entre seis y nueve años de una escuela pública de Curitiba (Paraná, Brasil) con probables dificultades de aprendizaje, realizado desde el 1 de marzo de 2002 hasta el 30 de junio de 2009. Los datos se obtuvieron simultáneamente por un equipo multidisciplinario en la evaluación inicial, con la aplicación del MMSE, de la LSP y del *Wechsler intelligence scale for children* (WISC III). Después de 2007 el *child behavior checklist* (CBCL) y el *teacher's report form* (TRF) fueron utilizados, siendo también comparados a la LSP. Los coeficientes de correlación entre las pruebas fueron calculados, siendo significante *p*<0,05.

Resultados: De los niños analizados, el 10% presentaba algún tipo de dificultad de aprendizaje, siendo el 76% del sexo masculino y el 24% del femenino. La franja de edad más prevalente fue entre seis y siete años. Historia familiar positiva ocurrió en el 45% de los casos y antecedentes obstétricos en 18%, siendo el bajo peso el más frecuente. El escore del MMSE mostró correlación con el del WISC III (r=0,73) y el CBCL mostró moderada correlación con el LSP (r=0,53).

Conclusiones: El pediatra puede utilizar el MMSE y la LSP como selección cognitiva y de problemas psicosociales en niños con dificultad de aprendizaje.

Palabras clave: aprendizaje; trastornos de aprendizaje; selección.

Introduction

Under-recognition of cognitive and psychosocial disorders is common in Brazil, particularly in public (government-run) schools. The impact of below-average intellectual development with significant limitations in adaptive behaviors, which defines mental retardation[1], has long held the attention of professionals involved in caring for children with learning disabilities. Conversely, psychosocial problems are given less consideration, although in recent years a questionnaire has been proposed to streamline recognition of these issues and enable early referral to specialized care[2,3].

Detection of learning disabilities, whether due to cognitive and/or psychosocial disorders, early intervention, and the implementation of preventive measures help mitigate the impact of these issues on learning, thus contributing to healthier development[4,5]. The term "learning disabilities" shall be used throughout this article to refer to children with academic achievement below that expected for their potential, as determined on evaluation by a multidisciplinary team[1].

Recent epidemiological studies show that 88% of Brazilian children are enrolled in public schools. Of these, 88.6% will graduate from fourth grade, 57.1% from primary education, and only 36.6% from secondary school[6]. Data from the Brazilian National Institute of Educational Studies and Research (INEP) show that 59% of fourth-graders cannot read, 22% cannot complete tests because they do not understand what is required, and approximately 50% have a math-specific learning disability[7]. In most Brazilian public schools, the issues that underlie learning disabilities are not always recognized by teachers. Several factors may account for this under-recognition, including excessive student numbers, precarious working conditions, and lack of adequate teacher training[8].

Therefore, it is essential that safe instruments be available that can alert pediatricians to the presence of underlying issues that may explain a learning disorder. The mini–mental state examination (MMSE) (available from author), due to its speed of administration (5–10 minutes) and the Pediatric Symptom Checklist (PSC) (available from author), which can be filled out in the waiting room by the child's caregiver, are assessment instruments that can be helpful in the identification of such issues[2,3,9,10].

In view of the relevance of this topic, the present study sought to assess the MMSE and PSC as screening instruments for referral of children with learning disabilities to specialized services, verifying their correlation with the scores of standard instruments such as the Wechsler Intelligence Scale for Children (WISC-III) and the Child Behavior Checklist (CBCL).

Method

This was a descriptive, cross-sectional chart review study conducted on a sample of schoolchildren referred to the Hospital de Clínicas do Paraná Pediatric Neurology Center (CENEP) by Escola Estadual Aline Picheth, a state-run primary school in Curitiba, state of Paraná, Brazil, between March 1, 2002 and June 30, 2009.

The criteria for inclusion were age between 6 and 9 years at the time of assessment, enrollment in the first or second grade at Escola Estadual Aline Picheth, and multidisciplinary assessment by a pediatric neurologist, clinical psychologist, educational psychologist, and social worker. Patients who did not meet these criteria were excluded from the sample.

Teachers identified students with learning disabilities and referred them to CENEP for multidisciplinary assessment. The initial stage of assessment consisted of a history, neurological examination, and administration of the MMSE and PSC by Pediatric Neurology residents and fellows, under the supervision of one of the investigators (I.B.). The clinical psychologist administered the WISC-III, the educational psychologist carried out specific academic assessments, and the social worker administered a social history questionnaire[11]. The CBCL and Teacher's Report Form (TRF) were used from 2007 onward. The results of initial assessment were later discussed in a meeting between the multidisciplinary team and school coordinators, followed by an exposition of the differential diagnosis and potential therapeutic approaches in a meeting between all team members and each subject's family. WISC-III and CBCL results were considered the gold standard for diagnosis of mental retardation or psychosocial problems respectively.

The MMSE, as modified by Ouvrier *et al*[10] for school-age children, consists of 35 items and can be administered by a pediatric neurologist or trained pediatrician. The instrument is designed to assess orientation, immediate and delayed recall, attention and calculation, language, and visual constructional skills. A score of zero is assigned if the child cannot complete the task or 1 if the child can complete it adequately, for a maximum score of 35. The PSC, designed for children between the ages of 6 and 16 and to be filled out by the child's parents or caregiver, comprises 35 items on the frequency of attention, internalizing, and externalizing symptoms. Scoring reflects the frequency in which the situation described in each item occurs, with zero being "never," 1 being "sometimes," and 2 being "often". The cutoff for positivity in the U.S. version of the checklist is 28 points, that is, children with a score of 28 points or higher should be referred to a specialist for mental health assessment[2,3].

The CBCL was adapted and validated for Portuguese by Bordin, Mari and Caeiro[12] in 1995. It is a broad, comprehensive, parent-report instrument, and is considered the gold standard for assessment of competencies and problems in children or adolescents between the ages of 6 and 18. It provides an analysis of the emotional, social, and behavioral profile of the evaluated subject. The CBCL is divided into two parts. The first concerns social competence – that is, the engagement and performance of the child or adolescent in sports, play, games, pastimes, chores and daily activities; scores are proportional to the social competence of the subject. The second part tests for emotional and behavioral problems. It comprises 118 items and is scored on a scale of 0 to 2, with zero being "not true," 1 being "sometimes true," and 2 being "very/often true". The sum of scores is converted into a T score according to gender and age. T scores are presented on syndrome scales, that is, with indicative score ranges for a series of problems that tend to occur together. A T score of 70 or above is considered clinical; 64–69, borderline clinical; and below 63, normal. For the internalizing and externalizing behavior scales, T scores of ≤60 are considered normal, 60–63 borderline, and >63, clinical. The TRF is a teacher-report questionnaire with the same characteristics and results of the CBCL. CBCL and TRF responses are tabulated in the proprietary Assessment Data Manager (ADM) software, which yields T scores and result plots.

The statistical methods employed were test for difference between proportions and Pearson's chi-squared test with Yates's continuity correction. Receiver operating characteristics curves were plotted for analysis of dichotomous variables and sensitivity and specificity values were estimated. The level of significance was set at 5% ($p<0.05$).

The study was approved by the Universidade Federal do Paraná (UFPR) Human Research Ethics Committee. The parents or guardians of all children provided informed consent for participation.

Results

Of 127 children referred, 24 were not added from the sample due to failure to meet all inclusion criteria. Therefore, the sample consisted of 103 children with learning disabilities, which corresponds to 10% of all students enrolled at Escola Estadual Aline Picheth during the study period. Seventy-eight children (76%) were male.

Table 1 - Mini-mental state examination (MMSE) and Wechsler Intelligence Scale for Children (WISC-III, U.S. and Brazilian version) scores of first- and second-graders enrolled at Escola Estadual Aline Picheth, Curitiba, Paraná, Brazil.

Instrument	Mean	SD	Median	Min	Max	n
MMSE	19.9	5.8	18	9	30	103
WISC-III, U.S. version (verbal)	95.5	18	92	46	135	98
WISC-III, U.S. version (performance)	84.8	18	82	46	115	98
WISC-III, U.S. version (total)	90.7	18	88	40	121	98
WISC-III Brazilian version (verbal)	109.9	19	104	79	146	72
WISC-III Brazilian version (performance)	93.2	19	90	69	129	72
WISC-III Brazilian version (total)	102.9	19	100	79	130	72

SD: standard deviation.

Mean age was 6.9±1.8 years (median, 7 years; range, 6–9 years). Of the 103 children in the sample, 55 (54%) were first-graders and 48 (46%) were second-graders; 45% had a positive family history of learning disabilities, 46% had a family history of attention deficit/hyperactivity disorder (ADHD), and 18% had a history of prenatal or perinatal abnormalities, with low birth weight the most common (11%). Forty-seven percent of children had a mean monthly household income of less than R$1195.00, and thus belonged to social classes C1, C2, D, or E[11].

Table 1 shows the result of cognitive assessments, including differences between MMSE, WISC-III (U.S. version) and WISC-III (Brazilian Portuguese) scores. The MMSE cutoff, considering a total intelligence quotient (IQ) >70, was 20 points for children aged 6–7 and 29 points for children aged 8–9. Therefore, MMSE scores ≥20 for children aged 6–7 and ≥29 points for children aged 8–9 were considered indicative of normal cognition (IQ >70).

The correlation between WISC-III (U.S. version) and MMSE scores is shown in Figure 1. Higher MMSE scores corresponded to higher WISC-III scores, with a Pearson correlation coefficient of .73 ($p<0.05$).

The PSC was administered to all 103 children in the sample. Positive scores (≥28) were obtained in 58 (56%), most of whom were male (57%), first-graders (70%), and aged 7 (40%).

Graph 2 shows the correlation between frequency of various clinical syndromes as detected with the CBCL and TRF. This reveals that rule-breaking behavior was perceived more often by teachers than by parents.

There was moderate correlation (r=0.53) between CBCL and PSC scores, as shown in Graph 3. The receiver operating characteristics curve yielded a cutoff point of ≥28 points, with 65% sensitivity and 97% specificity. The 65% sensitivity enabled detection of psychosocial disorders in a reasonable number of children by the PSC, of which 97% were confirmed by the CBCL (Graph 4).
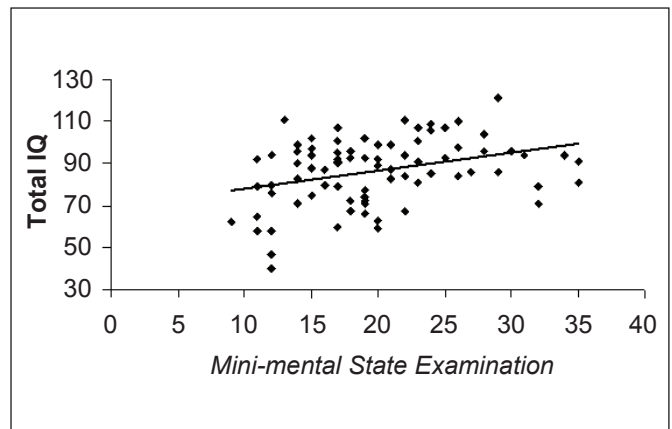
**Graph 1 -** Distribution of mini-mental state examination (MMSE) and total intelligence quotient (total IQ) scores of first- and second-graders enrolled at Escola Estadual Aline Picheth, Curitiba, Paraná, Brazil.

*internalizing symptoms; **externalizing symptoms
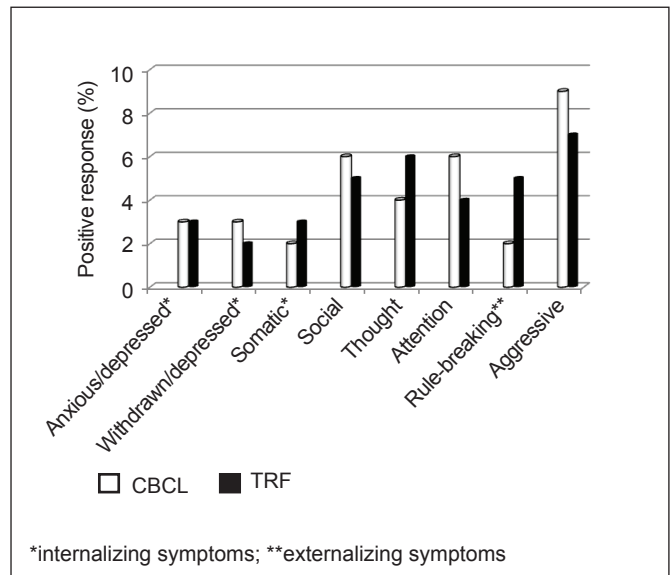
Graph 2 - Comparison between frequency of clinical syndromes as reported with the Child Behavior Checklist (CBCL) and Teacher's Report Form (TRF).
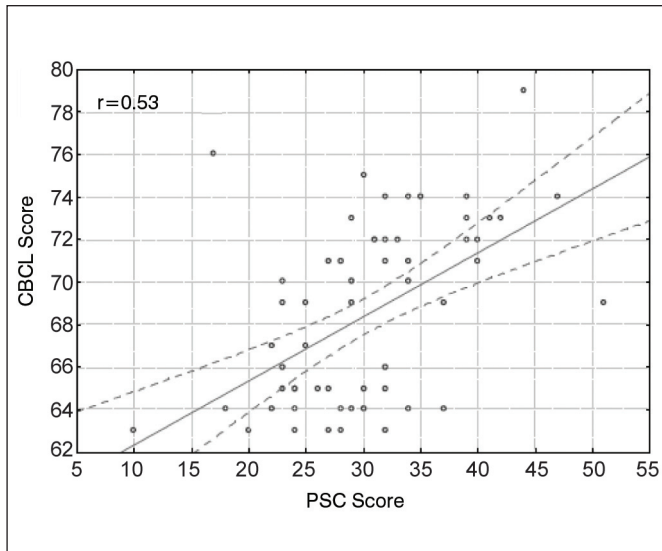
Graph 3 - Correlation between Child Behavior Checklist (CBCL) and Pediatric Symptom Checklist (PSC) scores.
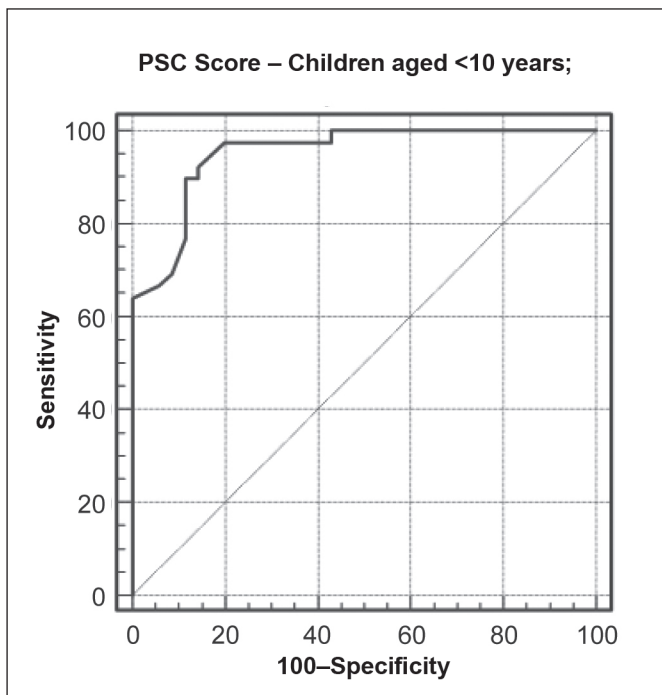
Graph 4 - Receiver operating characteristics (ROC) curve showing the cutoff point for Pediatric Symptom Checklist scores *(children aged <10 years)* and clinical Child Behavior Checklist scores.

Discussion

Pediatricians should be aware of and prepared for the care of children with learning disabilities, as early intervention can have a positive effect on the course of these

disabilities and minimize their impact on the child and on society as a whole[13,14].

In the present study, the prevalence of learning disabilities in first- and second-graders of a state-run school was 10%, with a 3:1 male-to-female ratio. Ciasca[15] also reported a male predominance (64%) of learning disabilities in this age range. In two U.S. studies, the prevalence of learning disabilities throughout elementary education ranged from 17 to 27%[16,17], whereas in Puerto Rico, the prevalence was 19.4%[17]. In the sample reported herein, 7-year-old first-graders were those most often referred for multidisciplinary assessment. This was consistent with the early diagnosis and intervention purpose of the study.

A positive family history of learning disabilities was found in 45% of cases, corroborating the findings of Lima *et al*[18], who reported an incidence of 37%. The children of parents with ADHD have 50/50 odds of developing the disorder, and the parents of approximately 30% of all children with ADHD report similar complaints[18]. On the basis of CBCL findings, 26% of children had a DSM-IV diagnosis of ADHD, and 46% had a positive family history of the disorder.

Pre- and perinatal health issues are closely related to learning disabilities. Neonates with anemia, hypoxia, low birth weight, or prematurity exhibit an increased incidence of ADHS and specific learning disabilities[19,20]. In the present study, 18% of children had had perinatal health issues, with low birth weight (11%) and asphyxia (3%), defined by a 5-minute Apgar score of 5 or lower, being the most frequent occurrences.

Few studies have assessed use of the MMSE in children. Ouvrier *et al*[10] and other authors[21-23] have found that scores increase with age, reaching maximum levels (35 points) around 9 years of age, and correlate well with psychometric measures of intelligence. In Brazil, Lorenzon[9] also found a positive correlation between total MMSE scores (maximum, 30 points) and age (r=0.6; *p*<0.0001).

Table 1 shows the mean MMSE and WISC-III (U.S. and Brazilian version) scores of children in our sample. The study population scored higher on the Brazilian version of the WISC-III than on the U.S. version of the test. One possible explanation for these differences is that the population used for development of the Brazilian version was much smaller than that of the U.S. version, precluding month-based age subdivisions, which are available on the U.S. version of the WISC-III. Therefore, an 85-month-old child (7 years, 1 month) will be assigned the same IQ of a

95-month-old child (7 years, 11 months), when the actual IQ should be lower. In the U.S. version of the test, the above example would yield an underestimate of the IQ. Therefore, although use of the Brazilian version is recommended, the possibility of erroneous scores – as proved in this study – justifies continued use of the U.S. version. In the present study, the receiver operating characteristics curve was plotted on the basis of U.S. WISC-III scores. A comparison between MMSE and WISC-III (U.S. version) scores is shown in Figure 1, with higher MMSE scores corresponding to higher WISC-III scores. The MMSE cutoffs were 20 points for children aged 6–7 and 29 points for children aged 8–9, that is, lower scores should prompt the pediatrician to refer the child for more in-depth cognitive assessment. Rubial-Alvarez *et al*[24] also found a positive correlation between MMSE, chronological age, and total IQ (U.S. version) (r=0.76; *p*<0.001).

Pediatricians fail to diagnose psychosocial problems in up to 43% of cases[25]. A U.S. study carried out in a low-income population showed that use of the PSC can streamline detection of psychosocial problems, increasing the prevalence of these issues to 18% – up from 1.5% prior to use of the instrument[26]. Most studies of the PSC have found that two out of every three children with a positive PSC score have moderate-to-severe emotional or psychosocial issues, which provides further evidence of the importance of this instrument as a screening test[25]. In the present study, the cutoff for PSC positivity was ≥28 points, with 65% sensitivity and 97% specificity. The 65% sensitivity enabled detection of psychosocial disorders in a reasonable number of children by the PSC, of which 97% were confirmed by the CBCL. Although this (65%) is still a suboptimal percentage of detection of psychosocial problems, nearly all PSC-positive subjects (97%) had their diagnosis confirmed by the CBCL. Similar findings were reported by Reijneveld *et al*[25] in the Netherlands (Graph 4) and by other authors elsewhere[2,3,26].

Muzzolon[27] showed the importance of the PSC as a screening instrument for psychosocial problems, finding that subjects (recruited from a public school) with a PSC score of ≥28 required referral to a specialized service for more in-depth assessment. Likewise, the good correlation between CBCL/TRF scores and PSC scores found in the present study proved that the PSC is a useful screening instrument for detection of emotional and psychosocial problems. Williams *et al*[28] also found good correlation between positive PSC scores and clinical CBCL scored

for ADHS, oppositional defiant disorder (ODD), anxiety disorder, and major depressive disorder.

Analysis of Graph 2 shows that CBCL and TRF yielded similar findings, with aggressive behavior being the predominant symptom in the sample, followed by attention problems, social problems, thought problems, and rule-breaking behavior. Conversely, Canino *et al*[29] encountered anxiety/depression, aggressive behavior, rule-breaking behavior, conduct disorder and inattentiveness, in this order. Costello *et al*[30] showed that improvement in socioeconomic condition reduced externalizing symptoms, with no effect on internalizing problems. In the present study, most children belonged to social classes C, D, or E, and aggressive behavior was the predominant issue detected. This corroborates the hypothesis of Costello *et al*[30] that economic fragility may predispose to externalizing symptoms.

In the present study, there is a possibility of reasonable correlation between the results of CBCL and TRF (administered from 2007 onward) and PSC scores, with the latter having potential as a screening instrument for detection of emotional and psychosocial problems if corroborated as such by more robust studies than those cited herein.

Early detection and intervention are essential to mitigating the negative academic and, later, social impact of learning disabilities on children and their families. Instruments that can assist pediatricians in this pursuit are highly valuable, as the pediatrician is most often in contact with children in the optimal age range for diagnosis and intervention. Furthermore, pediatricians usually have a close, long-standing relationship with their patients' families and are thus able to raise awareness of the importance of more in-depth assessment. The use of practical, validated instruments such as the MMSE and PSC can alert pediatricians to cognitive and psychosocial issues that may underlie learning disabilities, thus prompting referral for specialized care. Further studies of these instruments are of immeasureable importance to the early detection of learning disabilities and development of specific approaches for use in the unique socioeconomic and cultural contexts of Brazil.

Acknowledgements

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