

## Original articles

Screening and diagnosis of learning disabilities/  
disorders - outcomes of interdisciplinary assessmentsLarissa Solange Moreira Paterlini<sup>1</sup><https://orcid.org/0000-0002-6880-9602>Patrícia Aparecida Zuanetti<sup>1</sup><https://orcid.org/0000-0002-9847-2246>Angela Cristina Pontes-Fernandes<sup>2</sup><https://orcid.org/0000-0002-0852-2538>Marisa Tomoe Hebihara Fukuda<sup>3</sup><https://orcid.org/0000-0003-4360-4552>Ana Paula Andrade Hamad<sup>3</sup><https://orcid.org/0000-0002-1884-7264>

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## ABSTRACT

**Objective:** to determine the occurrence of children with poor school performance and to investigate which intrinsic influences are most prevalent among them.

**Methods:** a total of 104 children from the 1st grade to the 5th of elementary school participated in phase 1 (selection of children with poor school performance by a standardized test and based on average grade) and 56 of them (54%) were classified as having poor school performance. In phase 2 (differential diagnosis), 35 of these 56 children underwent multidisciplinary assessments and the results were submitted to a descriptive analysis.

**Results:** out of the 35 children who completed phase 2, 18 (51%) were diagnosed with mood disorder (2 - 6% depression; 16 - 45% anxiety disorder/signs), 14 (40%) showed attention deficit disorder and hyperactivity, 1 (3%) showed specific language disorder and 1 (3%) showed specific learning disorder. Among the most prevalent changes in reading/writing/arithmetic dysortography (19 children - 54%) and the presence of non-literate children (10 - 29%) were observed.

**Conclusions:** more than a half of the school-age children studied had learning deficits in written language and/or arithmetic, and the most prevalent intrinsic variables were internalizing disorders and the attention deficit/hyperactivity one.

**Keywords:** Learning Disorders; Specific Learning Disorder; Attention Deficit Disorder with Hyperactivity; Mood Disorders; Patient Care Team

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## INTRODUCTION

The latest data of the System of Assessment of Basic Education (SAEB in the Portuguese acronym) have indicated an alarming situation regarding basic education (BE) in Brazil. Regarding the learning level in the 5th year of BE, the reading/writing level was found to be adequate in only 11.9% of the children and to be insufficient (non-literate or early literacy level)<sup>1</sup>. Regarding math, 20% of the children in the 3rd year of BE did not know how to make simple additions and only 15.5% of children in the 5th year of BE showed an adequate learning level for math<sup>1</sup>.

Learning is defined as the ability to acquire new skills that permit the best adaptation of an individual to the environment<sup>2</sup>. It is a complex process originating from structural and functional modifications of the Central Nervous System and related to the number of times a neural pathway receives a stimulus<sup>3,4</sup>. The school learning process requires an evolutionary dynamism based on the maturation of upper cortical areas (gnosis, praxis, language, memory, and executive functions)<sup>3</sup>. It is the acquisition of upper cortical skills that will permit learning to read, to write, to interpret, to argue and calculate and to reason in a logical manner<sup>2,3</sup>. Thus, for adequate school learning, the development of the upper cortical skills must occur in each individual free from negative intrinsic or extrinsic interferences.

The intrinsic influences are either primary or secondary. The intrinsic ones refer to neurobiological changes that directly prevent an adequate development of some stage of the school learning process<sup>2</sup>. Among these neurodevelopmental conditions are the Specific Learning Disorder (SLD) and the Attention Deficit Hyperactivity Disorder (ADHD)<sup>2,4</sup>. Secondary influences, in turn, are due to conditions inherent to the child himself which indirectly interfere with learning, such as psychoemotional problems (anxiety disorder), chronic diseases, special needs of a motor or sensory nature, and others<sup>2</sup>.

Extrinsic interferences are those that are not intrinsic to the child, such as pedagogic inadequacy, low teacher qualification, adverse socioeconomic and cultural conditions, low parental schooling, and an unfavorable family environment<sup>2</sup>. These are the causes of school difficulties or are potentiating conditions regarding Learning Disabilities (learning deficit caused by intrinsic factors)<sup>4</sup>.

Based on the above considerations, some doubts arise. What is the percentage of children with poor school performance during their first years of basic

education? What are the most prevalent intrinsic factors in a sample of children with learning difficulties? A survey of these data provides a more detailed knowledge of the scenario of basic education in Brazil, permitting the elaboration of prevention and early remediation strategies. The aim of the present study was to determine the occurrence of poor school performance (1st-5th years of BE) and to investigate the most prevalent intrinsic influences in a sample of children with poor school performance.

## METHODS

This was an observational quantitative/descriptive study. The project was approved by the Research Ethics Committee of Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo – FMRP USP (Protocol nº 5932/2016) and all parents or persons responsible gave written informed consent to participate.

### Sample selection

The present study was conducted in partnership with a philanthropic school and consisted of two phases. The first, denoted “Selection of children at risk for learning disabilities” was conducted at the school itself, with the participation of a neurologist and of the teachers. The second phase, “Differential diagnosis”, occurred within a teaching hospital and involved a multidisciplinary team consisting of a child neurologist, a speech therapist, a neuropsychologist, and a psychiatrist.

The philanthropic school selected for partnership, in addition to following the curriculum required by the Ministry of Education (MEC), was involved in the formation of human values based on a broad sense of physical, mental and social well-being according to the health concept adopted by the World Health Organization (WHO). This school had rigid standards regarding parental participation, requiring the parents to attend a six month course for the clarification of school rules, teaching method and formation of human values, before the first enrollment in the institution. Each classroom had a maximum of 22 students, thus providing a better teaching environment. The age of the students between 6 and 10 years was chosen with the objective of obtaining an early diagnosis, since at more advanced ages the evaluation/intervention is impaired by increased academic and emotional losses.

The two phases of the study are described below:

- **Phase 1 – Selection of children at risk for learning disabilities:** all students aged 6 to 10 years and 11 months, attending the 1st to 5th year of BE, were included. In this first part of phase 1, we selected the children that would participate in the second part of phase 1. Selection was based on statistical analysis involving the mean and standard deviation of the final grades obtained by the children in each discipline in the preceding year.

Selection occurred in a didactic manner, as follows: the school provided the mean grade for each child for the disciplines Portuguese and Mathematics of the previous year. These values were used to calculate the general arithmetic mean per discipline in each classroom ( $x_j$ ), the individual general mean per student ( $x_i$ ), and the standard deviations related to these means ( $s_i$  and  $s_j$ ). We selected students with at least one final grade below the general arithmetic mean for the classroom minus one standard deviation ( $x_j - s_j$ ) and/or students who had obtained at least one final grade in some discipline below their individual arithmetic

mean minus one standard deviation ( $x_i - s_i$ ). It should be pointed out that 1st year students did not have grades for the previous year since concepts rather than grades are assigned in preschool. On this basis, the complaint of the teacher was considered to be the indicator of difficulty (i.e., 1st year children who the teacher thought to have disabilities were selected for the second part of this screening).

In the second part, children selected as having a mean below the standard deviation in relation to their classroom or to their own development and the 1st year children indicated by the teachers were submitted to screening using the School Performance Test (SPT)<sup>5</sup> and the Mini Mental Status Examination (MMSE) adapted for children<sup>6,7</sup>. Both instruments are described in the item “Instruments and Procedures”.

Children classified as having inferior performance in writing and/or reading and an adequate score for age in the MMSE were assigned to the second phase of the study.

Figure 1 illustrates the flow diagram for this first phase.

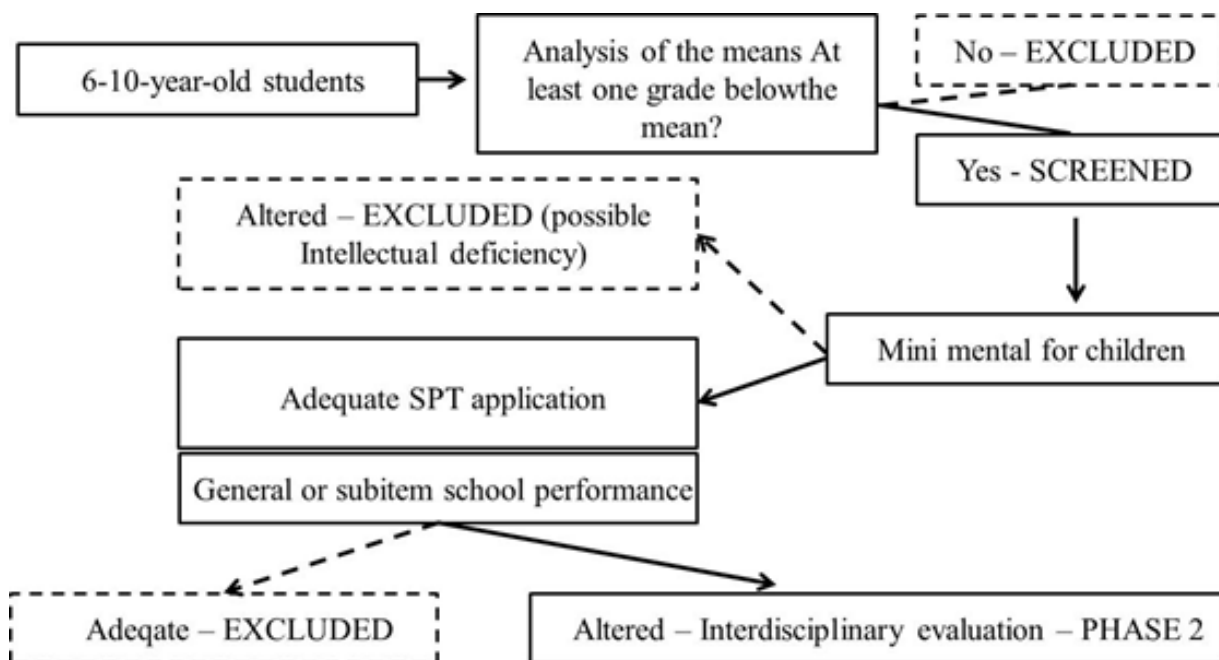


Figure 1. Flow diagram of Phase 1

In phase 1 we excluded children whose parents did not accept screening for school performance and children with a score lower than that expected for their age in the MMSE adapted for children.

- **Phase 2 – Differential Diagnosis:** the objective of this phase was to define which conditions (e.g.: ADHD, mood disorder and others) were the causes of poor school performance. For the definition of the differential diagnosis each child was submitted to interdisciplinary assessment. Briefly, assessment by the neurologist and psychiatrist consisted of an interview, the application of scales appropriate for the investigation of each neurodevelopmental condition, and physical/neurological examination. Neuropsychological assessment consisted of cognitive evaluation (intellectual estimate, executive functions and other skills) and emotional evaluation with instruments standardized for the Brazilian population. Speech and hearing screening consisted of the evaluation of auditory, speech and oral/written language (metalinguistic skills, reading/writing performance, and others), also using standardized instruments.

After evaluation by each professional, each case was discussed in order to determine if the changes in the reading/writing/arithmetic domains were disorders secondary to some other condition (e.g.: ADHD) or were specific learning disabilities. The diagnostic criteria were mainly based on the DSM 5<sup>8</sup>.

Children who missed some part of the interdisciplinary screening were excluded from phase 2.

## Instruments and Procedures

- **Mini Mental State Examination adapted for children (MMSE)<sup>6,7</sup>:** an instrument for the screening of higher cortical function that has been adapted for use in the pediatric population four years of age or older. It is considered to be a test sensitive to moderate and severe cognitive disabilities (intellectual deficiency),

but poorly sensitive, in a significant manner, to mild degrees. It is a questionnaire of easy and rapid application (5-7 minutes) for the assessment of orientation, attention-concentration, memory, constructional apraxia, calculation, and language. Children that did not reach an adequate score for age in the MMSE would have been excluded from this study, but no student was excluded according to this criterion.

- **School Performance Test (SPT)<sup>5</sup>:** a psychometric test that assesses school performance (word writing, arithmetic and word reading). It is possible to obtain a crude total score and another score for each subtest (writing, arithmetic and reading). Based on this score, it is possible to classify the performance of the child as adequate or inadequate for his age. Although the SPT needs reformulation for the current reality, with publication predicted for 2019/2020, it still is an instrument extensively used in clinical practice and in research since it is the only normative test available in Brazil for an ample evaluation of school performance<sup>9</sup>.

Statistical analysis was exclusively descriptive both for numerical and categorical variables.

## RESULTS

Table 1 presents the number of children enrolled in each school year and the percentage of students selected for screening (MMSE and SPT).

Among the 56 children selected for screening (Step 2 of Phase 1), 18 (12 boys and 6 girls) dropped out of the study because of lack of consent on the part of their parents or persons responsible, with a total of approximately 32% of the sample being selected for screening. Among these children who did not conclude the study, 15 had not failed any subject in the previous year and were selected for low performance in relation to themselves. The other three were 1st year students and therefore were not evaluated according to their grades

**Table 1.** Distribution of the students enrolled in the school and of the students selected for screening

School year	No. of students enrolled	No. of students selected according to grade	Percentage of students selected (%)
1st	21	6	28.6
2nd	21	12	57.1
3rd	19	10	52.6
4th	21	15	71.4
5th	22	13	59.1

of the previous year. Despite indication by the teacher, the parents did not consent to participate.

Thirty-eight children progressed to Phase 2, but three of them did not conclude the entire process of interdisciplinary evaluation by failing to attend the evaluations. Phase 2 data, Differential Diagnosis, refer to 35 children.

Table 2 presents the diagnostic hypotheses. ADHD and mood change (anxiety disorder, depression and significant signs of anxiety) were the most prevalent

conditions in the present sample. Comorbidities were observed in only 20% of the sample. Changes in reading, writing and arithmetic were considered to be secondary to ADHD, mood disorders and others in 94% of cases (the low performance in some school domain was due to the presence of the diagnosed condition). SLD (dyscalculia subtype) was observed in only one case (3%) and changes in learning due to specific language disorder were detected in another case.

**Table 2.** Diagnostic hypotheses proposed after multidisciplinary evaluation (Phase 2 of the study)

	No. of children	Percentage
ADHD - Inattentive	6	17%
ADHD - Combined	8	23%
Total of children with ADHD (combined + inattentive)	14	40%
Oppositional Defiant Disorder	2	6%
Specific Language Disorder	1	3%
Specific Learning Disorder - Dyscalculia	1	3%
Anxiety Disorder	11	31%
Signs of Anxiety (high risk for anxiety disorder)	5	14%
Depression	2	6%
Obesity	2	6%
Epilepsy	1	3%
History of Traumatic Brain Injury	1	3%
Hypothyroidism	1	3%
COMORBID Diagnostic Hypotheses	7	20%

ADHD – Attention Deficity Hyperactivity Disorder

**Table 3.** Number of children with low age performance in reading, writing and arithmetic (data of speech evaluation – Phase 2 of the study)

	No. of children	Percentage
Non-literate	10	29%
Arithmetic	10	29%
Orthography	19	54%
Reading comprehension	7	20%
Speech changes	2	6%

Non-literate children (29% - 10 children) also had a lower performance in arithmetic. Most children (54% - 19 cases) showed difficulties in orthography.

## DISCUSSION

The proposal of the current study was to investigate which intrinsic influences were present in a sample

of children with poor school performance. Thus, the study was conducted in two phases, the first being the selection of children with poor school performance and the second consisting of multidisciplinary evaluations. It should be pointed out that extrinsic variables (parental schooling and socioeconomic level) were not described in the present study since the school was

located in a low income neighborhood where these characteristics were homogeneous.

Fifty-six pupils were selected in phase 1 of the study, corresponding to approximately 54% of the enrolled students. Although alarming, this percentage was still lower than the values of the SAEB 2017 report<sup>1</sup> since, as stated in the introduction, at the national public education level, only 11.9% of the children showed an adequate learning level for reading/writing, and 15.5% did so for math at the end of the 5th year of BE. It can also be seen that the percentage for the 1st year (28%) corresponded to about half the value observed in the remaining years. This discrepancy may be attributed to the non-objective method used in the present study for the assessment of school performance of 1st year children. As mentioned in Methods, this group of students did not have grades from the previous year since no grades are attributed to nursery school children. On this basis, the complaint of the teacher was considered of value.

Phase 2 data revealed three major findings. First, mood disorders (anxiety disorder + signs of anxiety + depression) were the most prevalent condition in the present sample. Second, the prevalence of ADHD (40% of the children with poor school performance). Third, among the written language changes, dysorthography was the most prevalent, followed by non-literacy and poor performance in arithmetic.

Regarding the anxiety disorder, the estimate is that up to 10% of the children's population may have some pathological signs and symptoms of anxiety. The basis of this disorder consists of characteristics of excessive fear and anxiety and behavioral perturbations. Anxiety disorders differ from adaptive fear or anxiety by being excessive or persisting beyond appropriate periods of developmental level<sup>8</sup>.

A recent systematic review pointed out a positive relationship between the dyad of internalizing behaviors (depression and/or anxiety) and reading difficulty, although it was not possible to conclude which of these variables was the cause<sup>10</sup>. Several studies have stated that, when anxiety symptoms improve due to psychological therapy, for example, there can also be improved school performance and social functioning<sup>10,11</sup>. However, other studies have pointed out that children/adolescents with learning disorders are at risk to develop emotional problems<sup>12,13</sup>. Regardless of the cause-damage relationship in this dyad, it should be stated that educators should be prepared to recognize the symptoms of depression and anxiety since their

presence interferes with the performance of the student and with the use of learning strategies<sup>13</sup>. The learning ability of children with a diagnosis of mood disorders can be as deficitary or even more deficitary than that of children with intellectual deficiency<sup>14</sup>.

ADHD is a neurodevelopmental disorder, i.e., it is a condition that starts during infancy. Its essential characteristic is a persistent pattern of inattention and/or hyperactivity-impulsiveness that interferes with the functioning/routine of the child.

Inattentive behavior is associated with various underlying cognitive processes and persons with ADHD may exhibit cognitive problems in attention tests, executive function or memory<sup>8</sup>. Unsatisfactory school performance is one of the principal impairments caused by ADHD during infancy<sup>4,8</sup>. Population surveys have suggested that this condition occurs in most cultures, affecting about 5% of all children and 2.5% of all adults<sup>8</sup>. In the present study, the prevalence of ADHD among children with poor school performance was 40% (17% with the inattention subtype and 23% with the mixed subtype).

In contrast to the dyad internalizing behaviors/changes in reading and writing, ADHD is considered to be one of the main causes of poor school performance, with the contrary relationship being impossible. Children with ADHD have deficits of important cognitive skills necessary for the literacy process<sup>8,15,16</sup>.

The prevalence of other neurodevelopmental conditions such as specific language disorder and SLD (dyslexia and dyscalculia) was low, i.e., one child for each condition, 3% specific language disorder and 3% SLD). Specific language disorder is characterized by persistent difficulties in the acquisition and use of language in its various modalities (linguistic performance below expectations for the age range) which cause functional limitations of communication, social participation or academic performance<sup>8,17</sup>. In turn, SLD involves persistent difficulty in learning one or more of the fundamental academic skills (reading, writing, arithmetic) starting during the years of formal schooling and is a disorder of the normal pattern of learning of academic skills and is not a consequence of lack of learning opportunity or inadequate school education<sup>8</sup>.

Despite the lower prevalence of specific language disorder and SLD, in agreement with literature data<sup>8</sup>, these conditions should be considered and discussed with health and education professionals since they cause general linguistic impairment or impairment of only reading/writing in a lasting manner. Some linguistic problems persist even with the presence

of therapies<sup>8</sup>, posing a risk for the development of emotional problems due to the impairment of individual functionality if not properly managed<sup>8,17,18</sup>.

In the present study, dysorthography was found to be the most prevalent change of reading/writing/arithmetic. Dysorthography involves a writing pattern that escapes orthography rules conventionally established for a given language<sup>19</sup>. Dysorthography, when not associated with the SLD condition, dyslexia subtype, or with more general signs and symptoms of learning disability related to other conditions, may suggest that the school is not emphasizing the teaching of orthography due to the fragile theoretical and practical base of its educators, i.e., this result confirms a faulty teaching process<sup>20</sup>.

Orthography is a subject of difficult domain and cannot be acquired spontaneously by the learners. Its conventions should be explicitly taught at an appropriate time and according to appropriate strategies<sup>21</sup>. Intervention programs based on orthography rules are beneficial for children with dyslexia<sup>22</sup> and for students with learning difficulties and changes in secondary writing. These programs could be used by teachers, thus reducing the percentage of children with unsatisfactory school performance.

## CONCLUSION

The present study described the intrinsic variables related to the learning process. The most prevalent conditions among children with poor school performance were mood changes (anxiety and depression), followed by ADHD. Dysorthography was the most prevalent condition among the changes in reading, writing and arithmetic, followed by lack of literacy. These findings contribute to the organization of strategies more appropriate for the Brazilian reality on the part of managers/professionals, with the elaboration of intervention and prevention programs that can reduce the number of children with learning problems and thus, prevent losses during adulthood.

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