



ORIGINAL ARTICLE

## Screening for motor dysgraphia in public schools<sup>☆</sup>

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### KEYWORDS

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Rastreamento;  
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aprendizagem

### Abstract

**Objective:** To screen for warning signs of dysgraphia in schoolchildren at the sixth grade of elementary school.

**Method:** This was a descriptive, exploratory, cross-sectional cohort study performed with 630 schoolchildren assessed through the (adapted) Analytical Dysgraphia Inventory, which recognizes difficulties in writing through the tracing the graphics.

**Results:** A total of 22% (n = 138) of the sample presented all indications of dysgraphia; the most prevalent indicator was ascending/descending/fluctuating lines (53.6%). When the indicators were correlated to gender, males showed a significant difference (p < 0.05) in most of them. Among the warning signs of co-occurrences, dyslexia was the most prevalent indicator (22%).

**Conclusion:** Given the large number of warning signs of dysgraphia observed in schoolchildren, it is advisable to screen for these signs, in order to implement early interventions.

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### Rastreamento de disgrafia motora em escolares da rede pública de ensino

#### Resumo

**Objetivo:** Rastrear sinais de alerta para a disgrafia em escolares do 6º ano do ensino fundamental.

**Método:** Trata-se de um estudo descritivo, exploratório, de corte transversal realizado com 630 escolares avaliados através do Inventário Disgráfico Analítico (adaptado), que reconhece as dificuldades da escrita através do traçado dos grafismos.

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**Resultados:** Em 22% (n = 138) da amostra apareceram todos os indicativos de disgrafia, sendo que o indicador mais prevalente foi o de linha ascendente/descendente/flutuante (53,6%). Se correlacionados os indicadores ao gênero, os meninos apresentaram diferença significativa ( $p < 0,05$ ) na maioria deles. Dentre os sinais de alerta de co-ocorrências, a dislexia foi a que obteve maior indicador (22%).

**Conclusão:** Considerando o grande número de sinais de alerta para disgrafia encontrados nos escolares, torna-se pertinente o rastreamento para que uma intervenção precoce seja realizada.

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## Introduction

Writing learning disability, in which the child has a level of writing skill below the one expected for chronological age, intelligence, and educational level<sup>1</sup> is called dysgraphia in the specialized literature. It is classified into two types: the first is perceptual, where the child cannot make the connection between the symbolic system and the spelling that represent those sounds, words, and phrases; and the second is motor (dysorthography), where the child can speak and read, but has difficulty with the fine motor skills necessary to write letters, words, and numbers, that is, the child sees the graphic picture, but cannot make the movements necessary for writing.<sup>2</sup>

In addition to these classifications, there is another type of classification related to the symptoms. This classification includes the factors involved in the etiology of dysgraphia: developmental or primary dysgraphia, of functional or maturational origin; and symptomatic or secondary dysgraphia, conditioned to a pedagogical, neurological, or sensory component.<sup>2</sup>

Motor dysgraphia does not affect the symbolization of writing, rather the shape of the letters and the quality of writing. Etiologically, dysgraphia is due to maturational, emotional, educational, or mixed factors. Regarding the maturational factors, alterations in the psychomotor development may affect lateralization, psychomotor efficiency, body schema, perceptual-motor functions, and graphic expression of language.<sup>3,4</sup>

Regarding the emotional factors, emotional conflicts and psychological stress can lead to perceptual distortions and inaccuracies of tracing; this is related to attention and movement disorders, as well as to the individual's age.<sup>5</sup>

In the educational area, calligraphy alterations may be caused by inappropriate teaching, such as giving strict, inflexible, and forced instruction at the early stages of learning; setting unattainable goals for the child's developmental stage (involving demands for excellence and excessive speed); failure to identify the child's difficulties; and administration of postural guidance and appropriate exercises to prevent and manage difficulties.<sup>4,6</sup> Concerning the mixed factors, the graphics and posture that affect the writing, usually related to alterations in the representation of body schema and emotional imbalance, must be emphasized.<sup>4,5,7</sup>

Given the abovementioned factors, it is clear that the failure to achieve competence in writing during school-age years often has long-term adverse effects related to both academic success and self-esteem.<sup>8</sup>

Fine motor control, bilateral visual-motor integration, motor planning in the operation hand, proprioception, visual perception, sustained attention, and sensory awareness of the fingers are some of the component skills that are responsible for the act of writing.<sup>7</sup> Thus, bad handwriting may be related to intrinsic factors that refer to the child's ability to perform actual handwriting, to extrinsic factors related to environmental or biomechanical components, or both.<sup>8,9</sup>

In this context, the objective of this study was to screen for warning signs of dysgraphia through a reliable tool aimed at early intervention, as a disability in this area has an impact on the child's academic, emotional, and social development.

## Methods

This was a descriptive, exploratory, cross-sectional cohort study conducted in public schools of the city of São José do Rio Preto, state of São Paulo, Brazil.

The sample was selected from the public schools of São José do Rio Preto, which has approximately 400,000 inhabitants and 43 public schools. Thirteen schools from different neighborhoods were chosen by random sampling.

A total of 630 children attending sixth grade from 13 public schools were evaluated. The participants were identified (by name, age, gender, educational level of father/mother) and subsequently, the children were asked to write an essay to verify text production through the analysis of specific features according to the analytical dysgraphia inventory (adapted),<sup>10</sup> which recognizes the difficulties in writing through the tracing of graphics (illegible letters; graphics that allow letter confusion; angulation; touched-up letters; abnormal patterns of letters; ascending/descending/fluctuating lines). Children with hearing and vision problems, chronic diseases, and subnormal intelligence were excluded from this study. The test was applied in the school environment by previously trained teachers.

Analysis of variance (ANOVA) was used for the statistical analysis of the obtained results, with a significance level

**Table 1** Results of the correlation between gender and age with warning signs of dysgraphia.

Variables	Illegible handwriting	Angulations	Asc./des./fluct. lines	Abnormal letter patterns	Touched-up letters
<i>Gender (n = 630)</i>					
Female	35.2% (n = 12)	42% (n = 94)	47% (n = 158)	36% (n = 67)	38% (n = 46)
Male	64.7% (n = 22)	58% (n = 131)	53% (n = 180)	64% (n = 121)	62% (n = 76)
<i>p-value</i>	0.03*	0.048*	0.052	0.03*	0.045*
<i>Age</i>					
10 (n = 233)	26.4% (n = 9)	20% (n = 45)	30.1% (n = 102)	48.9% (n = 92)	42.6% (n = 52)
11 (n = 341)	41.17% (n = 14)	64% (n = 144)	57.3% (n = 194)	46.2% (n = 87)	36.06% (n = 44)
12 (n = 38)	11.7% (n = 4)	12% (n = 27)	9.5% (n = 31)	2.6% (n = 5)	13.1% (n = 16)
13 (n = 13)	14.7% (n = 5)	3% (n = 6)	2.6% (n = 9)	1.5% (n = 3)	5.70% (n = 7)
14 (n = 5)	6.3% (n = 2)	1% (n = 3)	0.5% (n = 2)	0.53% (n = 1)	2.45% (n = 3)

Asc./des./fluct. lines, ascending/descending/fluctuating lines.

\* $p > 0.05$  - chi-squared test.

of 5%. The number of errors, per letter, was calculated as a percentage of the possible writing events for each letter, in each item of the analyzed graphic. The study was submitted to the research ethics committee of the institution as determined by the National Health Council (Resolution 196/96). It was approved under protocol No. 396/2009, and was implemented after parents or tutors signed the informed consent.

## Results

The study comprised 630 literate children attending the sixth grade of elementary school. Of these, 289 were females and 341 males; the latter showed more indicators suggestive of dysgraphia. The mean age of the overall sample was  $10.75 \pm 0.84$  years, ranging from 10 to 14 years, and the majority was male (54%). The mean parental educational level was  $8.4 \pm 2.5$  years. 22% of the sample (n = 138) showed all factors indicative of dysgraphia.

When analyzing the tracing, represented by occurrences demonstrated in percentages, illegible handwriting accounted for 5.3% (n = 34); touched-up letters, 19.5% (n = 122); abnormal patterns of letters, 29.8% (n = 188); angulation, 35.7% (n = 225); and ascending/descending/fluctuating lines, the most frequent occurrence, accounted for 53.6% (n = 338).

Warning signs of co-occurrences of other learning disorders, such as dyslexia, were also observed; 22% of the sample presented a limited vocabulary and greatly reduced writing skill. Those were followed by dysorthography, which presented reiteration, agglutination, and translation in 20% of individuals; attention deficit hyperactivity disorder (ADHD), in 18% of schoolchildren; and finally developmental coordination disorder (DCD), which is represented by a lack of coordination (difficulty planning the tracing), found in 15% of the sample (n = 630).

When analyzing the warning signs of dysgraphia in the assessed schoolchildren, the correlation was performed by gender and age (Table 1).

## Discussion

As cross-sectional cohort studies provide a short-term image of the association to be assessed, they carry the burden of identifying only occurrences of the studied effect (prevalence bias) and their situation regarding the current exposure. This bias is particularly relevant in screening studies, due to the identification of suspects of a certain condition.<sup>11</sup>

This study aimed at screening for evidence of possible dysgraphia in schoolchildren, not diagnosis, as it was assumed that dysgraphia, as any other learning disability, involves a wide variety of factors, and thus the involvement of professionals from different fields is advisable to attain a more consistent diagnosis.<sup>12</sup>

Among the schoolchildren assessed, this study showed a prevalence of dysgraphia indicators in males.

The study by Berninger et al.<sup>13</sup> corroborates this result, showing that males have lower speed and accuracy in orthographic skills, which may be the source of gender differences in writing.

Regarding factors indicative of dysgraphia and co-occurrences of other learning disorders, it was observed that dyslexia was the most prevalent, as it was detected in 22% of the sample. It is not uncommon to find both disorders (dyslexia and dysgraphia)<sup>14,15</sup> in one child, and studies have highlighted that problems with writing can reveal alterations involving coordination, primary language disorders, spatial-visual deficits, attention and memory deficits, and sequencing problems<sup>16</sup> (Figures 1 and 2).

This study also demonstrated a high prevalence of ADHD concurrent to dysgraphia; these data are corroborated by other studies where children with ADHD had lower

performance regarding fine motor skills, and sensory and perception functions, when compared to students with good academic performance. These difficulties can cause significant impact on academic performance, hindering the development of written language and causing dysgraphia in these students.<sup>17,18</sup>

In the present study, which identified warning signs of dysgraphia, the most prevalent among the indicators was the general disorganization of the sheet, with no spatial orientation and text disorganization, as the child is not capable of writing in straight lines, stopping before or after the paper margins. The study by Rosenblum et al.<sup>19</sup> correlated this indicator with organizational skills, and found that children with organizational difficulties had the highest frequency of spatial disarray.

In Brazil, the literature is scarce regarding dysgraphia, and thus investigators have to rely on international studies.<sup>14</sup>

Regarding the analysis of all indicative factors, it was observed that 80 of the 630 (12.6%) children presented all the warning signs in their writing patterns, unlike other studies, which report a prevalence of approximately 8%.<sup>20,21</sup>

Considering gender, it was observed that females had a lower number of indicative factors than males. This difference was statistically significant in the analysis of some tracings (illegible handwriting, angulation, abnormal patterns of letters, and touched-up letters). Given this result, the data found in the present study are consistent with the literature.<sup>13</sup>

Regarding the association of factors indicative of dysgraphia and presence of other learning disorders, some characteristics were observed that suggest their co-occurrence; the most prevalent was dyslexia, a finding also verified in the study by Capellini et al.<sup>21</sup>

In this context, with the present sample, the next study will assess the presence or absence of dysgraphia through standardized tests and evaluations, characterizing their

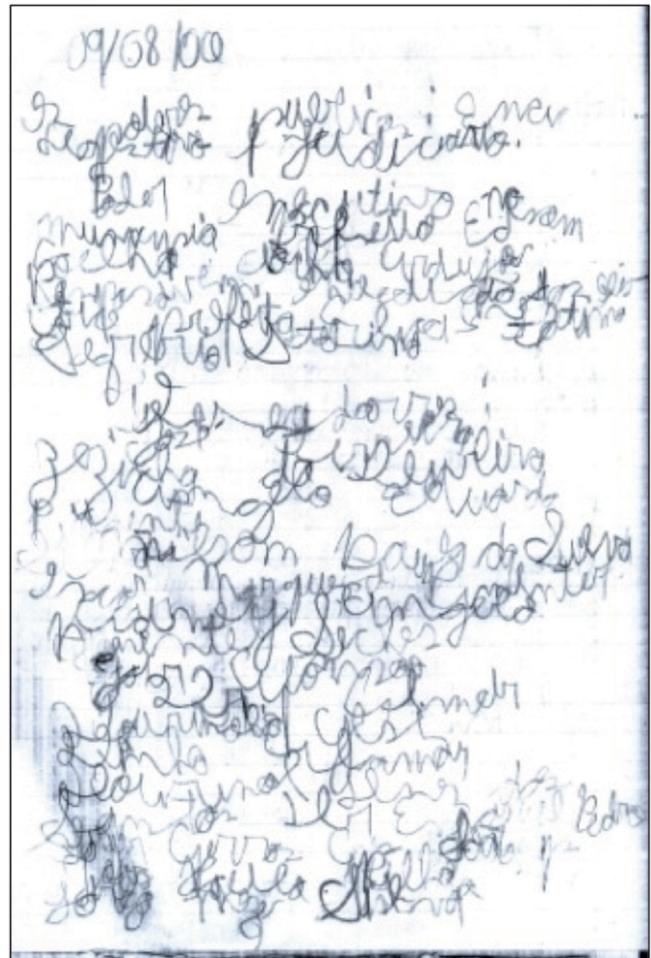


Figure 1 Sample showing dysgraphic text, containing all occurrences: unrecognizable letters; graphics that result in letter confusion, angles, touched-up letters, abnormal letters patterns, ascending/descending/fluctuating lines.

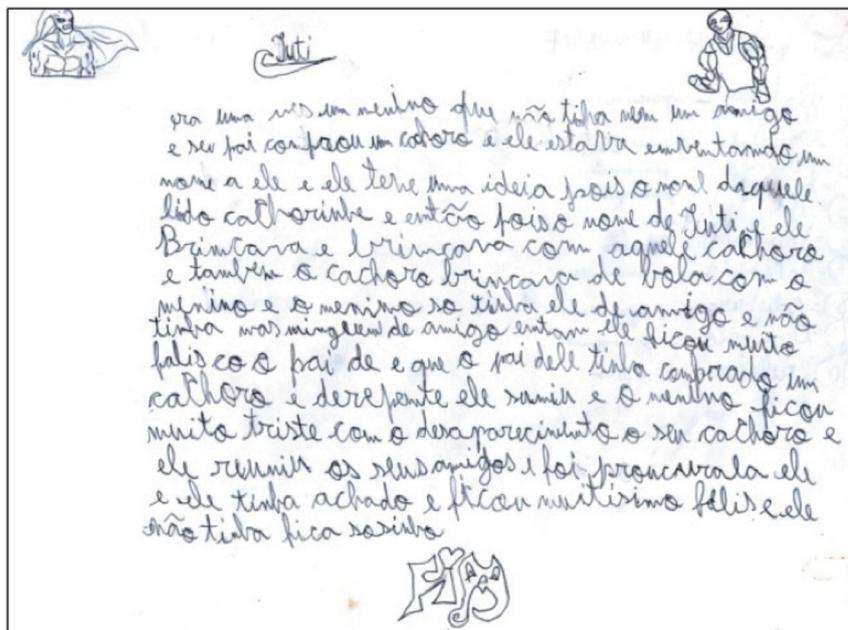


Figure 2 Sample showing text with dysgraphic and dysorthographic characteristics.

performance during the writing activity and their fine motor skills.

Considering that the analyzed results showed a high prevalence of indicators of dysgraphia in sixth grade, as well as the co-occurrence of other learning disorders through a simplified approach and screening tools, it is concluded that health care and education professionals must be able to identify and refer children at risk for writing disorders, advising the family to seek an etiological diagnosis so that timely and appropriate strategies can be implemented as early as possible.

## Conflicts of interest

The authors have no conflicts of interest to declare.

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