

Fine motor coordination and writing of 6-9 year-old children born preterm and full term*

Coordenação fina e escrita de crianças de 6 a 9 anos nascidas a termo e pré-termo

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ABSTRACT: *Objectives:* To investigate the relation between fine motor coordination and the quality of writing in school children born preterm and full term. *Method:* Description and comparison between the preterm group – 28 school children with gestational ages between 32 and 36 weeks, birth weight ≤ 2500 g; and full term group – 28 school children born at gestational age ≥ 37 weeks, birth weight ≥ 2500 g, paired by gender, age, school class and socioeconomic status. The parents of the school children in both groups completed questionnaires on motor performance and economic classification. Motor performance and writing were assessed by the Motor Coordination and Dexterity Assessment (ACORDEM), and the teachers completed questionnaires to identify motor coordination difficulties (DCDQ–Brazil), attention, and learning (EDTAH) deficits. *Results:* There were significant differences in some items of writing and fine coordination tests, and preterm infants tended to underperform in writing, fine and global coordination and were more prone to attention deficit and hyperactivity disorder. A correlation between performance in writing and some motor items was found. The results indicated greater probability of motor and writing difficulties among preterm school children, with implications for their care and education.

KEYWORDS: Infant, premature; Handwriting; Motor skills; Psychomotor performance; Motor skills disorders; Occupational therapy; Evaluation; Child.

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RESUMO: O objetivo deste trabalho consistiu em investigar a relação entre coordenação fina e qualidade da escrita em escolares nascidos pré-termo e a termo. Quanto ao método, utilizou-se de descrição e comparação entre: *grupo pré-termo* – 28 escolares, com idade gestacional entre 32 e 36 semanas, peso ao nascer ≤ 2.500 g, e o *grupo a termo* – 28 escolares nascidos com idade gestacional ≥ 37 semanas, peso ao nascer ≥ 2.500 g, emparelhados por gênero, idade, sala escolar e condição socioeconômica. Os pais dos escolares de ambos os grupos responderam a questionários de desempenho motor e classificação econômica. O desempenho motor e a escrita foram examinados com a Avaliação da Coordenação e Destreza Motora (ACORDEM) e os professores responderam a questionários para identificar déficits motores (DCDQ–Brasil), de atenção e aprendizagem (EDTAH). Sobre os resultados, constatou-se diferença significativa em alguns itens dos testes de escrita e coordenação fina, e pré-termos tenderam a desempenho inferior na escrita, coordenação fina e global e maior probabilidade de déficit de atenção e hiperatividade. Foi encontrada correlação entre o desempenho na escrita e alguns itens motores. Os resultados apontaram mais probabilidade de dificuldades motoras e na escrita entre escolares pré-termo, com implicações para assistência e educação dessas crianças.

DESCRIPTORES: Prematuro; Escrita manual; Destreza motora; Desempenho psicomotor; Transtornos das habilidades motoras; Terapia Ocupacional; Avaliação; Criança.

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INTRODUCTION

Among a wide set of factors considered to be of risk to the development and learning of children it is possible to highlight preterm birth and extremely low weight as biological risk factors, gestational age being an important and determining factor for the survival and the quality of life of newborns. To be defined as a preterm or premature newborn, a baby needs to be born before the 37th week of pregnancy.

Although most recent studies in the area being concentrated on the most extreme consequences of prematurity in newborns, some studies have been addressing aspects of development in late premature babies born with gestational age of less than (but closer to) 37 weeks^{3,4}. The late premature baby has been presented as that one born between the 34th and 36th week and with six days of gestational age³⁻⁶.

According to the literature, newborns, especially those with birth weight below 1,500 g, have a greater susceptibility to problems in the neurological and cognitive development mainly concerning more subtle changes/morbidities (yet clinically significant), such as delays in the development of motor skills, visual-motor abilities, in pre-schooling and schooling performance, in language evolution and in some behavioral aspects, if compared to the ones who were born at full term⁵⁻⁹.

Among the alterations regarding premature birth, the greater susceptibility to presents symptoms of Developmental Coordination Disorder (DCD) and Attention Deficit Hyperactivity Disorder (ADHD) can be highlighted. A recent meta-analysis of literature indicated that in-school-children with very low weight and very premature have from 5 to 8 times more probability of presenting motor coordination difficulties, even if these difficulties do not satisfy the criteria for the diagnosis of the DCD⁸.

Although in the last decade late or moderately premature babies have been seen by obstetricians and by pediatricians as clinically similar to babies born at full term, the late or moderate premature birth is heavily associated to morbidities of neurological development. Babies born between the 34th-36th week are three times more likely to have brain paralysis, besides also being more likely to present more moderate risks (which significantly increased), such as delays in the development, intellectual disabilities or both, if compared to babies born at full term³.

Other studies also indicated the school failure as a morbidity frequently associated to premature birth. These children are more susceptible to vulnerability in

several dimensions related to school readiness, such as health and physical development, social/emotional and communication/cognitive skills.

Among the abilities related to school performance, there is evidence of bigger inclinations for difficulties in writing among premature children, which would be a natural consequence of the lower development of sensorial and motor skills, especially concerning visual-motor coordination, essential for the acquisition of writing.

Despite the fact that motor deficit being associated to prematurity may affect writing, it was possible to locate only 2 studies that specifically address this issue of writing among prematurely born children. One of them focuses on the motor aspects related to writing, whereas the other addresses cognitive aspects. It can also be observed that there is still a need for new studies that aim to investigate the relation between prematurity and writing performance, focusing on motor aspects in the first years of schooling, mainly regarding late preterm babies, given that none of the studies found present data on the performance of Brazilian children.

Therefore, the present study, conducted as a master's degree dissertation at the Graduate Program in Occupational Therapy of Universidade Federal de São Carlos during the year of 2013 with granting by CAPES and the authorization of the Committee of Ethics under CAEE number 12059313.5.0000.5504, aimed to investigate the relation between the fine motor skill and the quality of the writing of moderately or late premature school children with the ones born at full term. The quality of writing and the subjacent motor skills, such as the visual-motor coordination and manual abilities, were compared to school children born premature – from moderate to late births – and children born at full term.

METHOD

This study was performed in Boa Esperança do Sul, a small town in the central region of the state of São Paulo, between January and July 2013. The choice of this city was due to the great number of cities of the same importance and due to its big representativity in the population context of the state and country. The city has an estimated population of 14,356 people – 12,184 of these being located in the urban area and 1.461 in the rural area (source: IBGE 2010). The mortality rates of children with less than one year of age in the city is 17.78 for every thousand, with fecundity rates of approximately 2.79 children per woman and a life expectancy of approximately 70.23 of age and the literacy rate of 85.65%.

The sample was composed by 2 groups, the first one comprising 28 prematurely born school children and 28 school children born at full term. For the establishment of the premature group, the following inclusion criteria were determined: birth between 2004 and 2006, gestational age of more than 31 but lesser than 37 weeks, weight at birth of below 2,500 g, to be regularly enrolled in the network of teaching of the city under study by 2013, to have between 6 and 9 years old, do not to present diagnosis or evidences of deficiency or need for special education, to have authorization of parents/guardians to participate in the study (Informed Consent Form).

The school children from the group born at full term were selected by the same criteria of age, year of birth, authorization of parents/guardians, deficiency diagnosis, in addition to the need for them to be born between the 37th and the 40th week of gestation with birth weight bigger than 2,500 g and also of being of the same gender, age, classroom and socioeconomic level of one of the children from the premature group (to make the pairing of groups).

The selection of samples started with premature in-school-children, a search for all children with history of prematurity in the period under study started being carried out through data from the Declaration of Live Birth (D.N.) of the city. Thus, it was possible to encompass all children with history of prematurity in the studied period. After the analysis of the D.N., extra residential and personal information of the children and its families were sought through the system of SUS National Health Card and also in public health clinics and in the Family Health Units. Thirty six (36) children that fitted in the inclusion criteria were identified, but after home searches the sample was reduced to 28 children – one of the children was not authorized by their mother, one of them died, 4 did not live in the city anymore and 2 presented intellectual deficiency. Therefore, the sample comprehended approximately 100% of the pre term children in school age that lived in the city and fitted in the inclusion criteria.

The full-term gestation group sample was composed as the premature school children were identified at the school. The teachers helped by indicating a full-term child in the same class of each premature one, who would fit in the inclusion criteria and in the pairing. After indicating the full-term child, the search for their parents/guardians started. Only the children that had obtained the authorization of their parents/guardians (TCLE) participated in this study.

All children were assessed by the following instruments:

Non-standardized interview script: with questions approaching the gestational and post-gestational history, personal, educational and professional information of the parents, family dynamics, and some school data of the children.

Developmental Coordination Disorder Questionnaire – Brazilian version (DCDQ-Brazil): an easily implemented questionnaire in which parents punctuate the motor performance of children in everyday life situations, comparing them to other children of the same age.

Assessment of the Motor Prowess and Coordination – ACOORDEM¹⁶: a specific standardized test for the detection of problems in the motor coordination of children aged between 4 and 8 years that is still under development, but already presents validation studies for Brazilian children¹⁶⁻¹⁹. The test is divided in 3 parts, considering that, in our study, the items applied were the ones that refers to coordination and manual skills together with two questionnaires (to parents and teachers) to assess the functional performance of children at home and at school. The assessment of the motor coordination and of the manual skills included two written items: the copy of the alphabet and of a short sentence, being punctuated according to the criteria of quality, which includes the time spent in the task.

The ACOORDEM was used because there were no other standardized tests validated for the written assessment of Brazilian children and also because it is one of the few tests with standards for motor performance of Brazilian children.

Parameters for the Attention Deficit Hyperactivity Disorder (ADHD) – Teacher’s edition (PADHD): a questionnaire created and validated in Brazil to identify behavioral symptoms of ADHD through the direct observation made by the teacher in the school context.

Criteria for the Economic Classification – Brazil (CECB): a questionnaire that allows the identification of social classes according to the purchasing power of the Brazilian families.

The interview script was composed by the questionnaires ACOORDEM, CCEB, and DCDQ-Brazil were given to the parents of children inside their home environment, whereas the teacher’s questionnaires of ACOORDEM and PADHD were answered by the student’s teachers. The part of ACOORDEM that corresponds to the assessment of coordination and motor skills, including writing, was applied individually in the school environment. As the children of the preterm group were assessed, the teacher was asked to indicate one child

born at full term by basing on the criteria of inclusion and pairing. According to the indication of teachers, parents were sought, and other instruments were applied in the children born at full term by following the same procedures.

To assure data reliability, the evaluator was trained to deal with assessment procedures and all testing was followed up by a second evaluator, that registered all data independently, reaching a consensus in cases of discordance.

The descriptive results include absolute and relative frequencies for categorical variables and, as for quantitative variables, measurements of central trend and dispersion were used. A comparison between the two groups was made by using the exact test of Fisher to verify if the pairing was appropriate. For the comparison of groups concerning the variables under study, given that the majority did not have the normality features, the categorical variables of the exact test of Fisher were used and, as for the others, the Mann-Whitney test was used. The questionnaires were analyzed using the sum of the scores of each item, and reckoned as the total score or sub-areas, as it foreseen for each instrument. The items of most relevant performance were individually analyzed, considering that some of these writing items were grouped in the total score of the test. The Spearman's correlation was used to investigate the relation between total scores in the two written tests (comprising the copy of the letters

of the alphabet and of a sentence), and the performance of the ACOORDEM tests for fine motor coordination and the manual skills in the preterm group. For all analyses, a level of significance of 0.05 was considered.

RESULTS

Characterization of the sample

As predicted according to the characteristics of the groups, the exact test of Fisher identified significant differences in some variables (Table 1); however, no significant differences were found between premature and full-term groups regarding the pairing criteria: age ($p = 0.954$), year of birth ($p = 1.00$), gender ($p = 1.00$), family income ($p = 0.861$), and economic classification ($p = 0.835$). With regard to family income, the average found was between 1 and 3 Brazilian monthly minimum wages.

Information on the follow up received by the mothers of premature newborns indicated that, in some cities, mothers are discharged from the hospital without any information regarding the potential consequences of prematurity, since 85.71% of the mothers declared not receiving any information on prematurity and its risks, 96.43% declared not having received any specialized medical assistance nor participating of follow-up programs for the development of newborns.

Table 1 – Characterization of the sample – neonatal data per group

	Premature			Full term			Sample Total			
	N	%	Average per group	N	%	Average per group	N	%	Total Average	p*
Gestational age (weeks)										
32	2	7.14	34.17	0	0	**	2	3.57	**	0.001
33	7	25		0	0		7	12.5		
34	8	28.57		0	0		8	14.29		
35	6	21.43		0	0		6	10.71		
36	5	17.86		0	0		5	8.93		
37 / > 37	0	0		28	100		28	50		
Age (Years)										
6	4	14.29	7.5	3	10.71	7.5	7	12.5	7.5	0.954
7	9	32.14		11	39.29		20	35.71		
8	12	42.86		11	39.29		23	41.07		
9	3	10.71		3	10.71		6	10.71		
Weight at birth (g)										
Up to 2,220 g	14	50	2078	0	0	3073	14	25	2575	0.001
2,230 to 2,500 g	14	50		0	0		14	25		
2,510 to 2,990 g	0	0		14	50		14	25		
3,000 g / > 3,000 g	0	0		14	50		14	25		

Note: *Fisher's exact test; **averages that could not be calculated due to the absence of precise information about the GI of the children who belong to the full term group.

With regard to the schooling of children that belong to the sample, 89.29% of the total sample studies in public schools, which corresponds to 25 children per group (preterm and full term), while only 10.71% were attending primary school in a private institution, which corresponds to 3 children per group.

The comparison of data on family dynamics revealed a significant difference ($p = 0.001$). There are more children from the preterm group only living with their mothers. In relation to family characteristics, there was also a significant difference between the groups concerning the level of schooling of parents, being the highest levels found among mothers in the full-term group.

Analysis of coordination, motor, and writing skills through the direct assessment of children

There was no significant difference between the groups ($p = 0.23$) concerning hand preference observed in motor and written tests, with predominance of hand preference for the right hand (78.57% of the premature and 89.29% of those gestated in 40 weeks), as well as there was no relation to pressure patterns and the type of handwriting used in the written tests. Among the premature ones, 57.14% used cursive writing, 21.43% block letters and 21.43% mixed the two handwriting patterns; in the full term group, 46.43% used cursive writing, 32.14% used block letters and 21.43% mixed the two handwritings.

In relation to the motor performance showed by the ACOORDEM test (Table 2), significant differences were not found between the two groups in any item; however, the preterm group has spent more time in the task, also making more mistakes in some one the items, especially in paper cutting exercises, but such difference did not reach significant statistical difference. As for the writing, a difference in the groups was only found in the number of correct alphabet letters copied, but, again, the preterm group tended to present worse performances in the majority of the items assessed.

The data analysis of the preterm group indicated a significant correlation (Spearman) among the total writing scores – the copy of the letters of the alphabet and of a sentence – and the score in some ACOORDEM tests of fine motor coordination and of manual skills (Table 3).

In DCDQ-Brazil, 10.71% of the preterm children presented signs of global motor coordination problems, whereas 100% of the ones full term gestated presented typical motor development. Although there is this small difference among the groups, the Fisher's test was no significant ($p = 0.236$); however, children with lower

weight at birth tended to present lower scores in the questionnaire.

In ETDAH, no significant differences were found among the groups regarding evidences of problems in the four areas of instrument – attention deficit, hyperactivity/impulsiveness, learning disabilities, and anti-social behavior – but there was a larger number of preterm children with evidence of presenting problems above average and a possible disturbance in the sub-areas: learning disabilities (preterm = 21.43% and full term = 10.71%) and attention deficit (preterm = 39.28% and full term = 17.86%).

In the ACOORDEM questionnaires answered by parents and teachers, there was a significant difference between the groups, with a worse performance of the preterm group in several areas (Table 4).

DISCUSSION

Although we did not find significant differences in the fine motor performance and in writing between preterm and full-term gestated children, such data shall be discussed in detail, because it reveals both aspects of assistance to the premature newborns in small towns of the countryside, as well as it allows us to infer on the motor development and on the necessary care for the education of these children.

Initially, it is important to highlight the lack of specific orientation to parents regarding prematurity after discharge. More than 85% of the mothers reported not receiving any information concerning premature birth and its potential consequences; only one of them reported that her son was on specialized monitoring after his birth because of its prematurity. This data is relevant when one considers the sample included almost 100% of preterm children born in the town, according to the criteria of inclusion.

Concerning motor aspects – with the inclusion of motor and writing tests –, no significant difference was found between the groups in any of the assessed items, except for the quantity of alphabet letters written correctly (Table 3), in which the preterm group had a worse performance. Although differences between the groups did not achieve statistical significance, the final score of writing tests, both for the copy of the alphabet as well as for the copy of the sentence, was inferior in the preterm group.

A tendency of being slower and of making more mistakes in the manual skills tests could be noted in a tracing test and in all tests that involved paper cutting in the preterm group, but without any statistical significance.

Table 2: Comparison between the groups in the tests of fine motor coordination, motor, and writing skills by ACOORDEM

Sub-areas and items by ACOORDEM	PRETERM		FULL TERM		p* value
	AVERAGE (±SD)	Median	AVERAGE (±SD)	Median	
PLAYING WITH THE HANDS (Time in seconds)					
To put studs in a board (favorite hand)	13.39 (±2.20)	13.00	13.54(±2.49)	14.00	0.784
To put studs on a board (non favorite hand)	15.14 (±2.56)	15.00	15.39 (±2.75)	15.00	0.869
To change the rows of studs	18.92 (±5.09)	18.00	19.33 (±3.79)	19.00	0.550
To put coins in the safe (favorite hand)	10.14 (±2.19)	10.00	10.00 (±2.19)	10.50	0.967
To put coins in the moneybox (non favorite hand)	12.37 (±3.53)	12.00	11.21 (±2.73)	12.00	0.222
Thumb-fingers test (favorite hand)	8.57 (±2.04)	8.00	7.64 (±2.32)	7.00	0.081
Thumb-fingers test (non favorite hand)	9.07 (±2.32)	7.00	8.32 (±2.71)	8.00	0.430
To distribute 20 cards	23.07(±9.45)	19.50	19.96 (±7.06)	19.00	0.264
Backstitching	44.25 (±20.05)	41.50	37.26 (±11.19)	36.00	0.102
DRAWING (Number of mistakes)					
Straight line	0.00	0.00	0.04 (±0.19)	0.00	0.317
Curved line	0.29 (±0.81)	0.00	0.29 (±1.08)	0.00	0.445
Butterfly trail	2.14 (±3.04)	1.00	1.50 (±2.47)	0.00	0.225
Copy of figures	5.32 (±2.00)	5.00	5.89 (±1.75)	6.50	0.306
CUTTING WITH SCISSORS (Number of mistakes)					
Straight cut	1.19 (±2.47)	0.00	0.27 (±1.00)	0.00	0.144
Square cut	4.04 (±4.50)	3.00	2.22 (±2.85)	1.00	0.065
Circular cut	3.93 (±4.52)	2.40	2.42 (±3.28)	1.00	0.187
Cat-shaped cut	9.11 (±7.74)	6.50	8.57 (±11.95)	2.00	0.132
WRITING					
Copy of the alphabet					
Time spent copying the alphabet letters (in seconds)	91.11 (±40.27)	84.00	102.75 (±43.72)	90.50	0.317
Total number of letters written (26 letters)	23.29 (±5.91)	26.00	24.86 (±6.64)	26.00	0.425
Total of letters correctly written	21.00 (±6.14)	23.50	23.07 (±5.39)	26.00	0.019
Speed (letters written per minute)	15.87 (±7.47)	15.40	15.37 (±6.82)	13.60	0.844
Copy of correct and readable letters (32 nd)	30.39 (±2.04)	31.00	31.18 (±1.09)	32.00	0.128
Total score of the copy the alphabet	44.86 (±3.03)	45.00	46.29 (±2.16)	47.00	0.061
Sentence copying					
Time spent in copying a sentence (in seconds)	58.54 (±45.58)	51.50	83.64 (±74.14)	62.00	0.356
Total number of letters written (45 letters)	33.25 (±19.64)	45.00	34.43 (±18.74)	45.00	0.916
Total of correct letters	32.11 (±18.09)	43.00	32.39 (±18.09)	42.50	0.712
Speed (written letters per minute)	30.22 (±23.87)	26.50	26.61 (±22.58)	20.65	0.604
Copy of correct and readable letters (36 th)	23.68 (±15.46)	31.50	25.75 (±14.16)	32.50	0.525
Total score of the copy of a sentence	36.75 (±20.19)	47.00	38.21 (±19.47)	48.00	0.565
Grade given by the teacher (from 0 to 10)	6.18 (±2.65)	7.00	6.89 (±1.87)	7.00	0.372

NOTE: SD = Standard Deviation; = maximum score; * Mann-Whitney test

Tabela 3: Correlation (Spearman) between the total punctuation in writing – copy of the alphabet and of a sentence – and the punctuation in the motor items and the questionnaire

	Alphabet Total	P value	Sentence Total	P value
To put studs on a board (favorite hand)	-0.483	0.009	-0.611	0.001
To put studs on a board (non favorite hand)	-0.105	0.594	-0.292	0.131
To change the rows of the studs (only with the favorite hand)	0.123	0.557	-0.178	0.393
Backstitching	-0.20	0.35	-0.284	0.179
To put coins in the moneybox (non favorite hand)	0.198	0.322	0.101	0.615
To put coins in the moneybox (favorite hand)	0.244	0.21	-0.013	0.95
To deal cards	-0.126	0.523	-0.464	0.013
Thumb (fingers of the favorite hand)	-0.026	0.894	-0.191	0.331
Thumb (fingers of the non favorite hand)	-0.006	0.975	-0.271	0.163
Straight cut	-0.408	0.034	-0.325	0.098
Square cut	-0.486	0.009	-0.602	0.001
Circular cut	-0.306	0.146	-0.417	0.043
Cat-shaped cut	-0.475	0.011	-0.570	0.002
Tracing – straight line	-0.321	0.096	-0.487	0.009
Tracing – curved line	-0.281	0.148	-0.366	0.056
Tracing – butterfly trail	-0.583	0.001	-0.594	0.001
Copy of figures (8 figures)	0.323	0.093	0.544	0.003
Total score at the DCDQ	0.158	0.421	0.354	0.064
Parent’s ACOORDEM questionnaire – mobility area	0.043	0.827	0.25	0.199
Parent’s ACOORDEM questionnaire – skills for VDS area	0.137	0.487	0.489	0.008
Parent’s ACOORDEM questionnaire – role of the student area	-0.373	0.051	-0.514	0.005
Parent’s ACOORDEM questionnaire – behavior, habits, and ordinary activities area	0.194	0.324	0.151	0.443
ACCORDEM teacher’s questionnaire – motor skills area	0.212	0.279	0.334	0.083
ACCORDEM teacher’s questionnaire – behavioral area	0.505	0.006	0.550	0.002

Table 4: Comparison between the groups in the parent’s questionnaire and the ACCORDEM teacher’s questionnaire

QUESTIONNAIRES	PRETERM		FULL TERM		p* Value
	AVERAGE (±SD)	Median	AVERAGE (±SD)	Median	
TEACHER’S QUESTIONNAIRE					
Motor scale	61.11 (±10.87)	63.50	69.68 (±8.23)	70.50	0.027
Behavior scale	29.11 (±8.08)	29.00	33.93 (±6.71)	36.50	0.024
PARENT’S QUESTIONNAIRE					
Mobility and ability to participate in games and children’s play	56.93 (±3.310)	57.50	58.11 (±2.97)	59.00	0.147
Skills to perform daily life activities	52.32 (±5.026)	52.50	56.07 (±2.07)	56.00	0.002

Skills related to the student’s role 35.46 (±4,558) 36.50 35.61 (±5.05) 37.00 0.613

Behaviors, habits, and routine 47.00 (±6,896) 47.50 51.71 (±2.87) 51.00 0.007

Note: SD = standard deviation; *Mann-Whitney test

In the writing tests, the preterm children tended to be faster, but with less precision, as indicated by the smaller number of alphabet letters correctly written. The results provide partial support to the findings on the literature on the commitment to writing and its sub-components of fine motor coordination and visual-motor control among preterm children. However, the small size of the sample of this study potentially limited the possibilities of achieving a statistical significance in a greater number of variables. It is important to emphasize the sample studied was made up by bordering and moderate premature children, in which high motor deficits cannot be expected. And also, it must be observed that given that teachers were instructed to help by recruiting pairs with similar functions level, they possibly have indicated children with a pattern of school development similar to the preterm pair, contributing to groups to also be homogenous in the performance tests. For future studies, we recommend the recruitment for the pairing be done through a sortition.

As far as the writing is concerned, a factor that appears to have specifically influenced the performance of both groups was the way that this skill is taught in the schools that were investigated. It was observed that both groups had great difficulties in writing tasks, difficulties that were beyond expected, once the sample included children from 6 to 9 years of age that ended up presenting huge difficulties of remembering all the alphabet letters as well as copying a simple sentence. Initially, when they were asked to do the tests with cursive writing, 42.86% of preterm children and 53.57% of full term children were not capable of using or keeping the pattern of the cursive handwriting, so that any type of comprehensible handwriting was scored. Still, the average number of alphabet letters correctly written varied from 21 (preterm) to 22 (full term) letters, out of 26. Furthermore, 25% of the preterm and 21% of full term births declared not to know how to write and, thus, they refused to copy a simple sentence. Considering the difficulty of the children, the scoring criteria for the items of the test had to be adapted to allow the punctuation of the sample, since the ACOORDEM only punctuates the cursive handwriting. In this study, we had to consider any kind of identifiable letter. These adjustments possibly influenced the capacity of the test to establish differences of performance between the groups.

The poor performance in writing in the sample as a whole may be related to the quality of teaching of the city's schools that may not offer the support and the appropriate stimulus for the good acquisition of writing. This hypothesis is based on the data of the national assessment

of the quality of teaching, conducted by INEP in 2011 through *Prova Brasil*, indicating that, in the first years of primary school, the results of the city were inferior to the numbers of reference of the state of São Paulo. Another trend that was observable was that, among private school children, the performance in the writing tests, for both groups, was more consistent; a greater facility to write was also observed.

As well as what was discussed by other authors, significant correlations between the total score in the writing tests and in the motor coordination (Table 3) were found mainly in the hardest motor tests, such as putting studs on a board by using their favorite hand, to cut paper in the shape of a square and of a cat and to draw a butterfly, which supports the comprehension of the writing as a complex motor activity.

With regard to questionnaires, considering the information provided by the teachers, the fact that only the behavioral questionnaire had a positive correlation with the writing has called out attention, being the children with the best behavior the ones who got a higher score in the two written tests. However, no correlation with the motor coordination section of the questionnaire that includes the items related to writing. This suggests that teachers are possibly more careful with behavior issues in comparison to the quality of writing. In the questionnaire answered by the parents there was a significant correlation between the skill to copy sentences and the performance in ordinary activities that share common aspects related to manual skills. On the other hand, a negative correlation between copying a sentence and skills related to the role of the student, which is a part of the questionnaire that includes several written items, was also observed. When the data was analyzed, it was observed that the parents scored much positively the skills of their children while doing school tasks, whereas the scores of the written tests were not as good scored. This data suggests the parents were not skilled in scoring the performance of their own children while doing school tasks, which can be explained by the low level of schooling of the parents of preterm children. We therefore recommend that the information regarding the parents on the performance in school activities be completed by the data collected with the teachers.

It is interesting to observe that, although no significant differences between the groups in the motor and written performance were found, as measured by observable items of ACOORDEM, parents and teachers seem to note difficulties in the preterm children, considering it was evidenced by the significant differences in two areas of the parent's questionnaire (AVD, habits and everyday life)

and in the two areas of the questionnaire of teachers (motor and behavior). Perhaps the direct motor assessment of the children, according only to the ACOORDEM criteria, is not sensible enough to detect the subtle motor differences that parents and teachers apparently can detect in school children at home and at school, given that motor deficits of the children cannot be only concentrated in the manual function.

In relation to the prevalence of ADHD symptoms, although it has not reached statistical relevance, there was a higher percentage of occurrence of problems compared to the average of the four assessment areas (hyperactivity, learning disabilities, anti-social behavior, and attention deficit) in the preterm group. Other authors^{10,24} have reported a higher predominance of attention deficit problems and motor coordination among preterm children, but in samples of children with lower birth weight and gestational age.

The differences found among the groups were subtle and many did not achieve statistical significance, possibly because of the small part of the town studied, even though it comprehended approximately 100% of preterm children born in the period studied and the heterogeneity of the sample regarding the children's age (from 6 to 9 years), which generated high standard deviations, especially in the

preterm group. It is recommended that in the next studies a greater homogeneity within groups be sought with the recruitment of groups that are representative according to age and full agreement with ACOORDEM, which would be useful to identify small problems of motor coordination.

The strength of this work is related to the fact that the sample comprehended approximately 100% of the city studied, the methodology of the location of preterm children used several mechanisms to locate the families and the fact the application of ACOORDEM was only performed after training and its joint application for reliability. The limitations of the study are the reduced number of participants and the way the group of full term children was indicated by the teacher instead of by sortition.

The preterm children seen to have more fine motor coordination and writing difficulties, in addition to have more symptoms of behavioral disturbances, even within the range of borderline prematurity. Therefore, orientations to mothers should be provided on the potential consequences of prematurity, as well as the provision of programs that follow up their development, and special attention should be also provided at school, so that these children receive a more careful treatment to their development.

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