REVISTA CEFAC
SPEECH, LANGUAGE, HEARING SCIENCES AND EDUCATION JOURNAL
Rev. CEFAC. 2017 Mar-Abr; 19(2):242-252 doi: 10.1590/1982-0216201719220815

Original articles

Performance of children with attention deficit hyperactivity disorder in phonological processing, reading and writing

Desempenho do processamento fonológico, leitura e escrita em escolares com transtorno de déficit de atenção e hiperatividade

Talita Fernanda Gonçalves-Guedim[1]
Iuri Victor Capelatto[2]
Cintia Alves Salgado-Azoni[2]
Sylvia Maria Ciasca[3]
Patrícia Abreu Pinheiro Crenitte[4]

[1] Faculdade de Odontologia de Bauru da Universidade de São Paulo, Bauru (SP), Brasil.
[2] Faculdade de Ciências Médicas da Universidade Estadual de Campinas – UNICAMP (SP), Brasil.
[3] Departamento de Neurologia da Faculdade de Ciências Médicas da Universidade Estadual de Campinas – UNICAMP (SP), Brasil.
[4] Departamento de Fonoaudiologia da Faculdade de Odontologia de Bauru da Universidade Estadual de Campinas – UNICAMP (SP), Brasil.

Conflict of interest: non-existent

Received on: December 17, 2015
Accepted on: February 02, 2017

Mailing address:
Talita Fernanda Gonçalves
Rua Canadá, 5-55, bl. 01, apto 306
Jardim Terra Branca, Bauru (SP), Brasil
CEP: 17054-070
E-mail: talita_fg@hotmail.com

ABSTRACT

Purpose: to compare the performance of students with Attention Deficit / Hyperactivity Disorder and students with good academic performance in Phonological Processing, Reading and Writing of real and non real words.

Methods: 30 students, aged between 9 and 12 years old, of both genders, of the elementary school in public and private education, participated in the study, divided into: Experimental Group (15 students with Attention Deficit / Hyperactivity Disorder) and Control Group (15 students with good academic performance), paired with Experimental Group as to age, gender, schooling, and type of educational institution (public or private). The instruments used for assessment were: Sequential Assessment Instrument (CONFIAS), Serial Rapid Naming Test (RAN), Test of Repetition of nonsense words and Test of Reading and Writing. The results were analyzed by statistical tests (Mann Whitney Test and T of Student), with a significance level of 5% (0.05), in order to compare the performance of the students.

Results: The results were analyzed by statistical tests and revealed significant differences between the experimental and control group in the tests evaluated.

Conclusion: the students with Attention Deficit / Hyperactivity Disorder had lower performance in phonological processing, reading, and writing words, when compared to students without Attention Deficit / Hyperactivity Disorder with good academic performance.

Keywords: Child; Assesment; Learning; Reading; Writing

RESUMO

Objetivo: comparar o desempenho do processamento fonológico, da leitura e escrita de palavras reais e inventadas entre os escolares com transtorno de déficit de atenção e hiperatividade e escolares com bom desempenho escolar.

Métodos: participaram deste estudo 30 escolares, na faixa etária de 9 a 12 anos, de ambos os gêneros, do Ensino Fundamental de escolas públicas e particulares, divididos em: Grupo Experimental (15 escolares com diagnóstico interdisciplinar de transtorno de déficit de atenção e hiperatividade) e Grupo Controle (15 escolares com bom desempenho escolar), pareado com o Grupo Experimental em idade, gênero, escolaridade, tipo de instituição de ensino (pública e particular). Os instrumentos utilizados para avaliação foram: Instrumento de Avaliação Sequencial (CONFIAS), Teste de Nomeação Seriada Rápida (RAN), Prova de repetição de palavras sem significado e Prova de leitura e escrita. Os resultados foram analisados por meio de testes estatísticos (Mann Whitney e Teste t de Student), adotando-se nível de significância de 5% (0,05).

Resultados: os resultados analisados por meio de testes estatísticos revelaram diferenças significantes entre o grupo experimental e o grupo controle nas provas avaliadas.

Conclusão: escolares com transtorno de déficit de atenção e hiperatividade apresentaram desempenho inferior em habilidades de consciência fonológica, acesso ao léxico, memória operacional, leitura e escrita de palavras, quando comparados aos escolares sem transtorno de déficit de atenção e hiperatividade, com bom desempenho escolar.

Descritores: Criança; Avaliação; Aprendizagem; Leitura; Escrita

INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is a neurobiological condition, more common in males, manifested in the childhood and adolescence and can persist into adulthood in 60 to 70% of cases. Evidence indicates neurological and genetic elements as possible causes, which reduces, but does not exclude environmental role in the contribution of the development of comorbidities. Its estimated prevalence is 3 to 5% of school children and their symptoms include difficulties in attentional behavior, hyperactivity and impulsiviness[1]. Usually these children are classified by the school society as undisciplined, distracted, impatient and extremely restless [2]. The diagnosis of ADHD is basically clinical, usually supported by operational criteria of classification systems such as the DSM-V [3].

In addition to the symptoms of the disorder, there is a high prevalence of comorbities[4]. The most frequent comorbidity in ADHD patients are: conduct disorder (50%), oppositional defiant disorder (40 to 60%), drug abuser or chemical dependency (40%), generalized anxiety disorder (34%), depression (20%), bipolar disorder (20%), obsessive compulsive disorder and motor tic (11%) Tourrete syndrome (6.5%), learning disorder (dyslexia, dyslalia, dysphonia, dysarthria, dyscalculia, dysgraphia (10%) among others[5].

There are evidences that children diagnosed with ADHD have more difficulty in learning by the influence of language significant changes and / or disorders in the appropriation of writing, pictures that can result in harm to the school performance [6].

Several studies have established a link between ADHD and learning disorders in written language reported that prevalent problems affect the performance and mastering in reading (8-39%) and writing (60%). These studies allowed to postulate hypotheses that children with ADHD language deficits are most likely related to hierarchicaly organized cognitive activities by organized behavior. These activities can be called as a whole, as executive functions and include goal setting, programming, initiation, control, inhibition of interference, fluency, speed, timing, sequencing, comparison, classification and categorization, which are associated with the cortical and subcortical systems of the frontal lobes. Furthermore, taking into account that subsequent acquisitions, such as reading and writing in alphabetic systems rely on aspects underlying spoken language, it can be expected that the language difficulties presented by these children have strong relationship with school deficits[7].

In this context, national and international researchers report that the mastery of certain skills such as phonological processing, composed by the phonological awareness, access to mental lexicon and the phonological working memory[8] should be taken as a predisposing factor for the acquisition and development of reading and writing.

The phonological[9] processing involves the process of using sound information of the language, necessary for oral and written language. Three skills are involved in this process: phonological awareness, rapid access to mental lexicon and the phonological working memory. The authors also point to a causal relationship between performance in phonological processing and reading capabilities [10].

Learning difficulties present in ADHD pictures inplicate possible changes in phonological processing, as for the development of reading and writing such skill is highly requested[11].

Language changes, commonly presented by individuals with ADHD, related to school performance are: difficulties in phonological organization of speech (change in sequential and temporal organization of phonemes); decoding, characterized by omissions and substitutions of words and phonemes; in coding, such as changes in sequential and temporal organization of grapheme; development of writing by changing the logical order of sentences and unorganized textual production[12].

Children with attentional failures or information processing will be difficult to trigger a refined visual processing, which compromise the phonological access required for the reading and writing of a alfabetical system[13].

The new perspectives of information processing analysis, derived from studies associated with cognitive psychology and neurology, which support the Speech and Language Pathology perspective, have contributed to the understanding of the difficulties in learning reading and writing.

Given the above, the objective of this work was to study comparatively the performance of students with ADHD and students with good academic performance in phonological processing tasks (phonological awareness, lexical access and working memory), reading and writing real words and nonwords.

METHODS

The study was approved by the Ethics Committee in Research with Human Beings of the Bauru Dental

School, University of São Paulo, Bauru (SP), Brazil. Case No. 65/2010. All responsible for school participants were instructed and received the Informed Consent Form (ICF). Only those students whose parents agreed to participate, signed and delivered the form to the researchers in the study.

Participated in this study 30 scholars, 24 (80%) male and 6 (20%) female, ranging in age from 9 to 12 years of age, enrolled in elementary school, public or private schools.

The students were divided into two groups:

- **Experimental group (EG):** 15 students with interdisciplinary diagnosis of Attention Deficit Hyperactivity Disorder - ADHD, combined type without comorbidity and without having started speech therapy. The diagnosis of ADHD was conducted by an interdisciplinary team of the Children's Neurology Clinic - DISAPRE Laboratory of the School of Medical Sciences – UNICAMP, Campinas - SP, including speech-language therapy evaluation, neurology, neuropsychology and according to the criteria in the DSM-IV TR[14]. During all interdisciplinary assessments, students who were using medication that promotes increased attention and controlling impulsive behavior were without medication.

  The criteria for the inclusion of EG were: be in care by the interdisciplinary team of Children's Neurology Clinic - DISAPRE Laboratory of the School of Medical Sciences – UNICAMP, Campinas – SP, be a minimum age between 9 and 12 years old, present interdisciplinary diagnosis of ADHD combined according to the DSM-IV TR criteria: not present comorbidities, not having started speech-language therapy, presenting collaborative behavior in the evaluation process. Patients who were on medication were instructed not to make use of the medicine for the evaluation sessions.

- **Control Group (CG):** 15 students without behavioral and/or learning disorders. These students were paired with students from EG following chronological age, gender, education and type of educational institution (public or private).

  These students were nominated by their teachers following the satisfactory performance criteria for two consecutive bimester, considering Portuguese Language and Mathematics subjects report. After that nomination, the students underwent clinical assessment. Only those who had development of oral and written language within the usual patterns and did not present hearing complaints participated in the study. Moreover, the intellectual performance should show within the normal range, according to psychological evaluation by a psychologist belonging to the interdisciplinary team of the institution. We also investigated possible visual changes. Also as inclusion criteria, the questionnaire SNAP IV[15] was applied to rule behaviors of inattention and hyperactivity.

Instruments used in the evaluation process

a) Phonological Awareness Assessment - Sequential Assessment Tool (CONFIAS) [16]: this test consists of two parts, the first corresponding to the syllabic awareness and the second corresponding to the phoneme awareness. Data analysis: the correct answers are worth one point and the incorrect are worth zero. In the syllable, the maximum score is 40 and the phoneme part 30, totaling 70 points, making 100% correct.

b) Rapid Access to Lexicon Assessment - Rapid Automatized Naming Test[17] : the test consists of four subtests for naming colors, digits, letters and objects. The subtests consists of five different stimuli, which alternate with each other, forming altogether ten sequential rows in a total of fifty

Variable	Level	Groups	
		EG	CG
		(N = 15)	(N = 15)
Sex	Male	40%	40%
	Female	10%	10%
Age	Minimum	9	9
	Maximum	12	12
	Average	10.1	10.1
	SD	1.245	1.245
Education	5th year	7	7
	6th year	2	2
	7th year	3	3
	8th year	3	3

Keys: EG: Experimental Group; CG: Control Group; N: number of individuals

Picture 1. Distribution of the sample by gender, age and education

stimuli. The color subtest was composed of the colors green, red, black, blue and yellow. The letters subtest was composed by the letters p, d, o, a, s. The digits subtest was composed of the following numbers: 6, 2, 4, 9, 7, and subtest objects consisted of comb, umbrellas, key, watch and scissors. Data analysis: Data were recorded in a specific protocol for this test, the time spent on each appointment of subtest was controlled and computed the total of mistakes.

c) Working Memory Assessment - word repetition test without meaning[18]: a list of 30 words without meaning in Portuguese was applied, organized into six sub-lists, each with five words, which vary according to the number of syllables from one to six, constituted by simple syllable structure, privileging consonant-vowel and consonant-vowel-consonant structures. For the analysis of the results, it was considered the point when the student was able to repeat the item as presented to it. The attempt was found to be incorrect when the student omitted, replaced, produced no sound or when he could not reproduce the item as presented by the examiner. In these cases, did not score. Analyzing the answers by list that was identified with the highest number of syllables that has counted with the correct repetition of five items.

d) Assessment of oral reading and writing under dictation: the procedure consisted of oral reading and writing under dictation of 2 sub-lists of 48 real words (RW) and 48 nonwords (NW), totaling 96 words in each category [19]. The lists that were presented to subjects are organized based on the phoneme-grapheme correspondence in the Portuguese orthography, creating three categories of words (regular, irregular and rule), and the frequency of occurrence (high frequency and low frequency). The analysis of the results in both tests was computed the total words read incorrectly for each category. The standards used to evaluate the performance of writing under dictation were similar to the Reading Test. the number of errors per item was computed. The error definition included the following cases: violation of phoneme-grapheme basic rules, with substitution, addition or omission of grapheme ("ora" instead of "nora") and violation of the correct form of words determined by the orthographic conventions ("tijela" instead of "tigela"). For different written pseudowords, hits were considered, since it was the resulting pronunciation according to the phonological dictation by the applicator. The sum of mistakes resulted in a total number of errors per item.

Data collection was performed individually in both groups. The evaluation of the CG took place at the school on opposite time to the school hours, while the collection of EG occurred at the Speech-Language therapy Clinic of the Bauru Dental School, University of São Paulo, Bauru (SP), Brazil. Both groups took the tests in the same order. The number of sessions for all participants varied depending on the individual characteristics and needs. Assessment sessions ranged, on

average, from two to three sessions, lasting 50 minutes, always respecting the disposition of each participant.

The results were analyzed using statistical tests, in order to compare the performance of reading and writing under dictation of children with ADHD and children with usual development. The comparative analysis of the groups was performed by the statistical Mann Whitney test and Student's t test, with significance level of 5% (0.05). Statistically significant results were marked with an asterisk (*).

RESULTS

EG's performance compared to CG in the Phonological Awareness Test

In the phonological awareness test, it was observed that the students from EG had underperformed the CG, both syllabic and phonemic subtests, there was a significant difference between the groups, evidenced by the Student t test (Table 1).

EG's performance compared to the CG in the Rapid Automatized Naming test

To compare the performance of the student's ability to access the mental lexicon measured by evidence of rapid naming, we used the Student t test. There was a significant difference in the test of access the lexicon of letters and digits (Table 2).

EG's performance compared to the CG in working memory test

For the analysis of the working memory data we used the nonparametric Mann-Whitney test, in order to compare the performance between the groups (Table 3). It was found that the students from EG presented a performance significantly below the presented by CG.

Table 1. Performance comparison between experimental group and control group in phonological awareness test

Variables	Group	Average	Standard Deviation	Significance (p)	t
PhA. Syl.	EG	29.47	5.87	* 0.00	5.199
	CG	37.53	1.30		
PhA. Phon.	EG	17.47	6.61	* 0.00	5.264
	CG	26.87	2.03		
Total	EG	46.93	11.99	* 0.00	5.488
	CG	64.40	2.85		

Keys: EG: Experimental Group; CG: control group; PhA Sil: Syllabic Phonological Awareness; PhA Phon: Phonological Awareness Phonemic. Student's t test.

Table 2. Performance comparison between experimental group and control group in the Rapid Automatized Naming test

Variables	Group	Average	Standard Deviation	Significance (p)	t
RN Colors	EG	51.16	16.43	0.09	1.707
	CG	42.44	11.01		
RN Letters	EG	41.74	14,30	* 0.00	4.298
	CG	25.13	4.43		
RN Digits	EG	38.38	16.37	* 0.00	3.016
	CG	25.27	3.96		
RN Objects	EG	42.37	24.59	0.57	0.565
	CG	38.01	16.93		

Keys: RN Colors: Rapid Automatized Naming of Colors; RN Letters: Rapid Automatized Naming of Letters; RN Digits: Rapid Automatized Naming of Digits; RN Objects: Rapid Automatized Naming Objects. EG: Experimental Group; CG: Control Group. Student's t test.

Table 3. Performance comparison between experimental group and control group in the test of Working Memory

Variables	Group	Average	Standard Deviation	Significance (p)
WM	EG	3.73	0.80	* 0.00
	CG	5.13	0.52	

Keys: WM: Working Memory. EG: Experimental Group; CG: Control Group. Mann Whitney test

EG's performance compared to the CG in reading real and nonwords

To compare the reading performance of real words of high and low frequency it was used the nonparametric Mann-Whitney test, with significant differences in reading the words (Table 4).

In reading nonwords, we used the Student t test for independent samples, and thus it was observed that there was significant difference between the averages of the groups with the highest number of errors for students of EG (EG: Average = 4 13, SD = 2.53; CG: Average = 0.60, SD = 0.63, t = 5.244, p = 0.000).

In Table 5, are the writing test results under dictation. It was observed that there was a significant difference between the groups, with superior performance for the CG in comparison to writing words under dictation.

For the analysis of the performance of writing under dictation of real words of high frequency it was used the nonparametric Mann-Whitney test (EG: average = 2.53, SD = 2.39; CG: average = 0.20, SD = 0 , 41; U = 31.5, p = 0.000). To compare the performance on writing under dictation of low frequency words and nonwords, we used the Student t test (Table 5).

Table 4. Performance comparison between experimental group and control group in the proof reading of real and nonwords

Variables	Group	Average	Standard Deviation	Significance (p)
RWHF	EG	2.13	2.59	* 0.00
	CG	0.00	0.00	
RWLF	EG	2.40	2.59	* 0.00
	CG	0.07	0.26	

Keys: RWHF: Real Words High Frequency; RWLF: Real Words Low Frequency. EG: Experimental Group; CG: Control Group. Mann Whitney Test.

Table 5. Performance comparison between experimental group and control group in writting under dictation of real and nonwords

Variables	Group	Average	Standard Deviation	Significance (p)	t
WD. RWLF	EG	3.20	2.40	* 0.02	2.438
	CG	1.53	1.13		
WD. NW	EG	6.60	4.34	* 0.00	3.564
	CG	2.33	1.63		

Keys: WD. RWLF: Writing under dictation Real Words Low Frequency; WD. NW: Writing Under Dictation of nonwords. EG: Experimental Group; CG: Control Group. Student's t test.

DISCUSSION

ADHD causes losses to school adjustment, interpersonal relationships and school performance, interfering with the child's learning process. Furthermore, attention, essential for complex activities such as reading and writing, prove to be affected.

It is known that phonological processing, object of interest of many studies, has been recognized as a component part of the development process of the reading decoding and writing encoding. Changes in phonological processing skills (phonological awareness, lexical access and working memory) greatly impair the development of reading and writting[20]. Children with difficulties in this processing presents changes in reading fluency and problems with reading comprehension due to deficits in phonological awareness and low information storage capacity of working memory. Phonological working memory and phonological access to mental lexicon allow the processing and organization of language. Similarly, they are requested by the central executive component in the performance of any task, including the phonological awareness and phoneme-grapheme[21] association. Understanding that the student with ADHD show deficits in executive function, this study admitted the hypothesis that involved activities in phonological processing, reading and writing could prove to be impaired when analyzed in comparison to the performance of usual students.

According to the results obtained in this study, we found that the performance of EG was statistically lower than the performance of the CG in the Phonological processing skills. The study suggests that these difficulties may be related to reading and writing changes in children with ADHD, since they found deficits in phonological awareness and operacional memory[22].

Studies show that the Phonological awareness has a reciprocal relationship with the learning of reading and writing [22]. According to the results obtained in phonological awareness test, students with ADHD had lower performance than obtained by the CG, especially with regard to the notion of phonemes (Table 1). Children with ADHD had therefore deficits in metaphonological language skills, which may be related to the results observed in the reading and writing assignments [22].

This research supports the findings that impairments in learning acquisition in individual with ADHD involve possible changes in metallinguistic skills, as for the development of reading and writing such skill is highly required. Advances in research are increasingly demonstrating the nature of the phonological deficit. This processing refers to the mental abilities of information processing based on the phonological structure of oral language and is formed by the components involving the acquisition of reading and writing: phonological awareness, requiring, therefore, attentional resources.

To perform tasks of phonological awareness it takes time and greater attention and concentration[23]. These data suggest that the performance in this ability may be changed due to the characteristics of diagnosis itself, in which children with ADHD have attentional and hyperactivity change, affecting the retention information[24].

Regarding access to the lexicon, the findings of this study showed that children with ADHD had difficulties to quickly name the stimuli related to letters and digits, and found statistically significant differences in these tests. However, for the evidence of colors and objects, there was no significant difference between the groups (Table 2).

However, it can be argued that if the relationship between Rapid Automatized Naming and reading is due to the speed and efficiency with which lexical codes are accessed in long-term memory, then the type of stimulus should not make any difference in prediction of the test results, since all test stimuli (letters, numbers, colors, and objects) must be translated from their visual representation in their correct phonological correspondents. However, contrary to this idea, several studies have found that colors and objects do not relate to the ability to read as well as the letters or digits[25]. Thus, this suggests that there may be other cognitive skills that are required for the serial nomination, which are also shared during the reading, which are different from the efficient retrieval of phonological codes (naming objects and colors) [26].

Also in this regard, one can argue the fact that the naming of figures always require access to the meaning for the subsequent production of the name. On the other hand, the reading of words can be performed without going through this process, or for the identification of a grapheme or digit no need to access the meaning. Thus, colors and objects have a greater semantic load[27]. Diferently of naming colors and objects (they are more subject to word phonological training for naming), the naming of numbers and letters tend to have greater automaticity. However, this automaticity is achieved depending on the age and good learning ability of letters and numbers. It is suggested therefore enlarge the corpus of the sample to confirm this trend.

The literature discusses the relationship of automaticity in Rapid Automatized Naming (RAN) speed. Basically, this theory suggests that the more familiarized the child is to name letters, more automatic becomes the process of naming them[28].

Regarding the development of lexical access and its relationship with reading, a study showed that children aged 5 and 6 years old often names colors and objects faster than letters and numbers. However, with greater exposure and practice in relation to letters and numbers, the naming of alphanumeric stimuli becomes more automatic. At this point, the alphanumeric stimuli are named faster and become more strongly associated with the ability of reading[29]. These differences highlight the importance of considering the alphanumeric stimuli RAN separately from non-alphanumeric stimuli. It is also important to consider the predictive ability of RAN between the groups, as one study suggested that the predictive value may be different for individuals with reading difficulties and usual readers[30]. Studies also reveal that RAN's correlations with reading skills are stronger in individuals with reading difficulties than usual readers[31].

Thus, according to the above reported literature, the low performance of participants with ADHD in rapid naming skills of digits and letters can relate to reading difficulties observed in this group, that hypothesis can be confirmed in further studies.

The students of EG in this study had a lower score to the CG performance of working memory, as shown in Table 3. Children with ADHD have greater inattention and this would probably be one of those responsible for the performance lowered in operacional memory [28,32].

Previous research has shown that individuals with ADHD often have working memory deficit, thus impairing the reading and writting learning performance[33].

Working memory refers to the ability to retain and manipulate information temporally. Operational memory difficulties affect much of the information processing since the memory is a mediating structure of information [32].

With this regard, author[34] posits that working memory is not just a temporary reservoir of information, but also has an active executive role in information processing. The author designed the organizational model of working memory as a storage system consists of three components: a central executive and two slave systems, which are the phonological loop (related to representation and recitation of verbal material) and visuospatial buffer system (imagistic equivalent of the phonological loop). For the author, the central executive is the main component of the theory, and among other functions, is responsible for maintaining attention and concentration.

Thus, in this study, difficulties with working memory found in individuals with ADHD can be attributed to problems in the executive component, ie. in maintaining attention and concentration.

Another study[35] found that children with ADHD had lower performance result in the control group in auditory working memory, which did not occur in visual working memory. The authors reported that this finding was related to the lower reaction time, and that these effects may be due to the need for greater effort to maintain attention. For the authors, children with ADHD have greater inattention, which would probably be one of the responsible for the poor performance in this skill, which corroborates the results of this study.

For learning reading and writing it is necessary for the school to be able to associate an auditory phonemic component with a graphic visual component. As for understanding the alphabetic principle is to understand that spoken language can be segmented into different units, these units are repeated in different words and that there are rules of correspondence between graphemes and phonemes, demonstrating the importance of phonological awareness for development of reading and writting[36].

It is through the perception and understanding of the graph-phonemic correspondence that the child is able to perform the reading of any regular word, as, to find new words, it may apply the rules of phonological decoding. Phonological processing refers to information processing operations based on the phonological structure of oral language and involves perception and working memory[37] and these give support to the phonological reading of the word.

Analyzing the working memory has an important role in tasks requiring phonological awareness, since the verbal material should be kept in this memory to perform such tasks[10], was expected performance difference between the two groups, demonstrated in both evaluations performed.

Working memory plays a crucial role in many complex cognitive activities such as learning, reasoning and language comprehension. In this sense, failures in the system can harm the development of speech and language, lexical acquisition in the process of learning,

reading and understanding a text and in solving math problems[38]. There seems to be evidence that working memory plays an important role in the tasks that request phonological awareness, since the verbal material should be kept in this memory at the time of realization of such tasks[10].

Thus, the results found in this study as reading and writing real words and nonwords shown that children with ADHD have a lower performance when compared to the CG. These difficulties, not expected for age and education, may be related to changes in phonological processing skills. Regarding reading test, it observed that the performance of EG proved to be lower than expected when compared to the control group (Table 4), change in the decoding of the requested words. Attention problems contribute to difficulty in reading and writting[39].

Changes in reading in a ADHD child are due to the sequential disorganization and time of the phonemes needed to perform the proposed activity, resulting in an impairment of reading, a report that also corroborates other findings of this study - which is the change in phonological awareness, specifically in phonemes [21].

In the present study, we used the reading and writing of real words of high and low frequency and nonwords. It was possible to verify both in reading and in writing, that the students of both groups performed better in reading and writing real words than nonwords, better performance in reading high frequency words in low frequency and in nonwords, suggesting a more efficient use of reading and writing by the lexical route. The more the child has perceptual, auditory and visual contact, with words, the more these words become familiar. Thus, the child will read and write better high frequency words than the lower frequency and the real words more than nonwords[40] .

For the occurrence of decoding of real and nonwords, It is necessary to engage some skills such as, visual and auditory processing, the conversion mechanism grapheme / phoneme, attentional processes, lexical access and working memory. Children with ADHD show changes in areas concerned with the attentional demand of self-regulation, working memory and phonological awareness, which may suggest a relationship between the difficulty of reading by phonological route and ADHD, as seen in the results of this study.

CONCLUSION

ADHD children with difficulty in reading and writing of this study showed lower performance in phonological processing skills (Phonological Awareness, Access to Lexicon and Working Memory), when compared to students without ADHD with good academic performance.

REFERENCES

1. American Psychiatric Association. Diagnostical and statistical manual of mental disorders. 4a ed. Washington DC: American Psychiatric Association; 2000. Disponível em http://virtualpsy.locaweb.com.br/dsm.php.
2. Jou GI, Amaral B, Pavan CR, Schaefer LS, Zimmer M. Transtorno de déficit de atenção e hiperatividade: um olhar no ensino fundamental. Psicol. Reflex. Crit. 2010;23(1):29-36.
3. American Psychiatry Association. Diagnostic and Statistical Manual of Mental Disorder. 5 ed. Washington, DC: APA, 2013.
4. Dorneles BV, Corso LV, Costa AC, Pisacco NMT, Sperafico YLS, Rohde LAP. Impacto do DSM-5 no Diagnóstico de Transtornos de Aprendizagem em Crianças e Adolescentes com TDAH: Um Estudo de Prevalência. Psicol Reflex Crit. 2014;27(4):759-67.
5. Reinhardt MC, Reinhardt CAU. Transtorno de déficit de atenção/hiperatividade, comorbidades e situações de risco. J. Pediatr. 2013;89(2):124-30.
6. Boada R, Willcutt EG, Pennington BF. Understanding the comorbidity between dyslexia and attention-deficit/hyperactivity disorder. J Top Lang Disorders. 2012;32(3):264-84.
7. Cunha VLO, Silva C, Lourencetti MD, Padula NAMR, Capellini SA. Desempenho de escolares com transtorno de déficit de atenção e hiperatividade em tarefas metalinguisticas e de leitura. Rev. CEFAC. 2013;15(1):40-50.
8. Andrade OVCA, Prado PST, Capellini SA. Desenvolvimento de ferramentas pedagógicas para identificação de escolares de risco para a dislexia. Rev Psicoped. 2011;28(85):14-28.
9. Wagner RK, Torgesen JK. The nature of phonological processing and its causal role in the acquisition of reading skills. Psychol Bull. 1987;101(2):192-212.
10. Gindri G, Keske-Soares M, Mota HB. Memória de trabalho, consciência fonológica e hipótese de escrita. Pró-Fono R Atual. Cient. 2007;19(3):313-22.

11. Alves LM, Souza HTV, Souza VO, Lodi DF, Ferreira MCM, Siqueira CM et al. Processamento Fonológico em indivíduos com Transtorno de Déficit de Atenção e Hiperatividade. Rev. CEFAC. 2014;16(3):874-82.
12. Silva, RA, Souza, LAP. Aspectos linguísticos e sociais relacionados ao Transtorno de déficit de atenção/ hiperatividade. Rev. CEFAC. 2005;7(3):295-9.
13. Banaschewski T, Ruppert S, Tannock R, Albrecht B, Becker A, Uebel H et al. Colour perception in ADHD. J Child Psychol Psychiatry. 2006;47(6):568-72.
14. American Psychiatric Association. Diagnostical and statistical manual of mental disorders (DSM-IV TR). Porto Alegre: Artmed, 2002.
15. Mattos, P et al. Apresentação de uma versão em português para uso no Brasil do instrumento MTA-SNAP-IV de avaliação de sintomas de déficit de atenção/ hiperatividade e sintomas de transtorno desafiador e de oposição. Rev. Psiquiatr. 2006;28(3):290-7.
16. Moojen S, Lamprecht R, Santos RM, Freitas GM, Brodacz R, Siqueira M. et al. CONFIAS Consciência Fonológica: Instrumento de Avaliação Sequencial. 2003; São Paulo: Casa do Psicólogo.
17. Ferreira TL, Capellini SA, Ciasca SM, Tonelotto JMF. Desempenho de escolares leitores proficientes no teste de nomeação automatizada rápida – RAN. Temas Desenvolv. 2003;12(69):26-32.
18. Kessler TM. Estudo da Memória de Trabalho em pré-escolares [dissertação]. São Paulo (SP): Universidade Federal de São Paulo, Escola Paulista de Medicina; 1997.
19. Pinheiro AMV. Leitura e escrita: uma abordagem cognitiva. Campinas: Psy II, 1994.
20. Piasta SB, Wagner RK. Learning letter names and sounds: effects of instruction, letter type, and phonological processing skill. J Exp Child Psychol. 2010;105(4):324-44.
21. Oliveira AM, Cardoso MH, Pinheiro FH, Germano GD, Capellini SA.Desempenho de escolares com dislexia e Transtorno de Déficit de Atenção e Hiperatividade nos processos de leitura. Rev. Bras Cresc Desenv Hum. 2011;21(2):344-55.
22. Voorde SV, Roeyers H, Verté S, Wiersema JR. Working memory, response inhibition, and within-subject variability in children with attention-deficit/ hyperactivity disorder or reading disorder. J of Clín and Experim Neuropsy. 2009;32(4):366-79.
23. Asberg J, Dahlgren S, Sandberg AD. Basic reading skills in high-functioning Swedish children with autism spectrum disorders or attention disorder. Research in Autism Spect Dis. 2008;2(1):95-109.
24. Cavadas M, Pereira LD, Mattos P. Efeito do metilfenidato no processamento auditivo em crianças e adolescentes com Transtorno do Déficit de Atenção/Hiperatividade. Arq Neuro-Psiquiatr. 2007;65(1):138-43.
25. Schatschneider C, Fletcher JM, Francis DJ, Carlson CD, Foorman BR. Kindergarten prediction of reading skills: A longitudinal comparative analysis. J of Educ Psych. 2004;96 (2):265-82.
26. Logan JAR, Schatschneider C, Wagner RK. Rapid serial naming and reading ability: the role of lexical access. Read and Writing. 2011;24(1):1-25.
27. Mousinho R, Correa J. Habilidades lingüísticocognitivas em leitores e não-leitores. Pró-Fono R Atual. Cient. 2009;21(2):113-8.
28. Bowers PG. Tracing symbol naming speed's unique contributions to reading disabilities over time. Reading and Writing. 1995;7:189-216.
29. Meyer MS, Wood FB, Hart LA, Felton RH. Selective predictive value of rapid automatized naming in poor readers. J. Learn. Disabil. 1998;31(2):106-17.
30. Norton ES, Wolf M. Rapid automatized naming (RAN) and reading fluency: Implications for understanding and treatment of reading disabilities. Annual Rev of Psych. 2012;63:427-52.
31. Frijters JC, Lovett MW, Steinbach KA, Wolf M, Sevcik RA, Morris RD. Neurocognitive predictors of Reading outcomes for children with Reading disabilities. J. Learn. Disabil. 2011;40(2):150-66.
32. Bolden J, Rapport MD, Raiker JS, Sarver DE, Kofler MJ. Understanding phonological memory deficits in boys with attention-deficit/hyperactivity disorder (ADHD): dissociation of short-term storage and articulatory rehearsal processes. J Abnorm Child Psych. 2012;40(6):999-1011.
33. Shue KL, Douglas VI. Attention deficit hyperactivity disorder and the frontal lobe syndrome. Brain and Cog. 1992;20(1):104-24.
34. Baddeley, A. Exploring the central executive. The Quarterly J of Experim Psych. 1996;49(1):5-28.
35. Ferreira TL. Avaliação da memória de trabalho auditiva e visual em crianças com transtorno do déficit de atenção e hiperatividade [dissertação]. Campinas (SP): Universidade Estadual de Campinas, Faculdade de Ciencias Médicas; 2011.

36. Guimarães SRK. Dificuldades no desenvolvimento da lectoescrita: o papel das habilidades metalinguísticas. Psicol Teor Pesq. 2003;19(1):33-45.
37. Cardoso-Martins C, Pennington BF. Qual é a contribuição da nomeação seriada rápida para a habilidade de leitura e escrita? Evidência de crianças e adolescentes com e sem dificuldade de leitura. Psicol Reflex Crit. 2004;14(2):387-97.
38. Santamaria VL, Leitão PB, Assencio-Ferreira VJA. consciência fonológica no processo de alfabetização. Rev. CEFAC. 2004;6(3):237-41.
39. Walcott CM, Scheemaker A, Bielski K. A Longitudinal Investigation of Inattention and Preliteracy Development. J Attention Disorders. 2010;14(1):79-85.
40. Snowling M, Gallagher A, Frith U. Family risk of dyslexia is continuous: individual differences in the precursors of reading skill. Child Devel. 2003;74(2):358-73.