

# Reading competence of words and pseudo words, school performance and listening skills in primary schools

## Competência leitora de palavras e pseudopalavras, desempenho escolar e habilidades auditivas em escolares do ensino fundamental

Cintia Alves de Souza<sup>1</sup> , Andrezza Gonzalez Escarce<sup>2</sup> , Stela Maris Aguiar Lemos<sup>2</sup> 

### ABSTRACT

**Purpose:** To associate the word and non-word reading competence of students aged from 7 to 10 years according to variables as gender, age, school performance and auditory abilities. **Methods:** Observational analytic cross-sectional study with a non-probabilistic sample. The study was conducted with 109 students of three educational institutions. The Word-Pseudoword Reading Competence Test, the Test for School Achievement, the Sound Localization Test, the Sequential Memory Test for Verbal and Non-verbal Sounds were used as instruments. **Results:** In most children the Word-Pseudoword Reading Competence Test showed normal results. Most students showed low performance in the Test for School Achievement. The Simplified Auditory Processing Test resulted in a higher percentage of adequacy of the sound localization ability, followed by the auditory ability of simple temporal ordering for non-verbal sounds and verbal sounds. There was a significant association between the results of the Word-Pseudoword Reading Competence Test and the Test for School Achievement and its subtests. **Conclusion:** The study revealed an association between word and non-word reading competence and school performance of children aged from 7 to 10 years, 11 months and 29 days. However, there was no evidence of association between word and pseudoword reading competence, sociodemographic variables and auditory abilities.

**Keywords:** Academic institutions; Auditory perception; Understanding; Reading; Language; Speech therapy

### RESUMO

**Objetivo:** Associar a competência leitora em palavras e pseudopalavras de escolares de 7 a 10 anos de idade, segundo as variáveis sexo, idade, desempenho escolar e habilidades auditivas. **Métodos:** Estudo observacional analítico transversal, com amostra não probabilística composta por 109 escolares. Foram utilizados como instrumentos o Teste de Competência de Leitura de Palavras e Pseudopalavras, o Teste de Desempenho Escolar, o Teste de Localização Sonora, o Teste de Memória para Sons Verbais em Sequência e o Teste de Memória para Sons Não Verbais em Sequência. **Resultados:** O Teste de Competência de Leitura de Palavras e Pseudopalavras apresentou resultado normal na maioria das crianças. No Teste de Desempenho Escolar, a maioria dos escolares apresentou desempenho inferior, conforme critérios de classificação do teste. A Avaliação Simplificada do Processamento Auditivo resultou em maior porcentagem de adequação da habilidade auditiva de localização sonora, seguida pela habilidade auditiva de ordenação temporal simples para sons não verbais e para sons verbais. Houve associação significativa entre os resultados do Teste de Competência de Leitura de Palavras e Pseudopalavras e do Teste de Desempenho Escolar e seus subtestes. **Conclusão:** O estudo revelou associação entre a competência leitora em palavras/pseudopalavras e o desempenho escolar de crianças de 7 anos a 10 anos, 11 meses e 29 dias. Contudo, não houve evidência de associação entre a competência leitora em palavras/pseudopalavras, as variáveis sociodemográficas e as habilidades auditivas.

**Palavras-chave:** Instituições acadêmicas; Percepção auditiva; Compreensão; Leitura; Linguagem; Fonoaudiologia

Study conducted at Departamento de Fonoaudiologia, Curso de Fonoaudiologia, Faculdade de Medicina da Universidade Federal de Minas Gerais – UFMG – Belo Horizonte (MG), Brasil.

<sup>1</sup>Curso de Fonoaudiologia, Faculdade de Medicina, Universidade Federal de Minas Gerais – UFMG – Belo Horizonte (MG), Brasil.

<sup>2</sup>Departamento de Fonoaudiologia, Faculdade de Medicina, Universidade Federal de Minas Gerais – UFMG – Belo Horizonte (MG), Brasil.

**Conflict of interests:** No.

**Authors' contributions:** CAS was responsible for data collection and analysis, writing of the manuscript and approval of the final version; AGE participated in the work guidance, data collection and analysis, writing of the manuscript, approval of the final version; SMAL was responsible for the study design and guidance of all stages of the work, data analysis, writing of the manuscript and approval of the final version.

**Funding:** Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) - Edital Universal - 14/2012 e Fundação de Amparo à Pesquisa do Estado de Minas Gerais – FAPEMIG - Edital 01/2013 - demanda universal.

**Corresponding author:** Cintia Alves de Souza. E-mail: [cintiasouzafono@gmail.com](mailto:cintiasouzafono@gmail.com)

**Received:** April 13, 2019; **Accepted:** July 15, 2019

## INTRODUCTION

Reading comprehension is a complex process that begins when the reader has contact with the text and it later develops through the activation of several cognitive processes in a way that the entire reading and comprehension pathway occurs satisfactorily<sup>(1)</sup>. Among these interrelated cognitive processes, the following are noteworthy: the ability to process, store, and retrieve information, the ability to recall, to think, to reason, to logic, as well as the auditory and visual processing. This context encompasses jointly the basic reading processes, such as the recognition, i.e. the decoding of words, and the extraction of the meaning of printed words, which, although necessary, are not sufficient for comprehension to occur<sup>(2-5)</sup>. Thus, it can be said that a person may in fact understand a text that was read, whenever she is able to decode it and use the contained information in future actions. For this reason, reading comprehension plays an important role in the literacy process, as it constitutes the basis for learning in many areas of knowledge<sup>(1,6)</sup>.

The learning process takes place individually, due to the influence of variables such as brain maturation and the environment in which the infants are inserted<sup>(7)</sup>. Despite this particularities, there are some prerequisites for this process to happen satisfactorily. Thus, keeping the focus on school learning, achieving a good performance is conditioned to the development of writing, reading and arithmetic skills<sup>(8)</sup>.

Therefore in the literacy process, reading competence develops in stages – the logographic, alphabetic and orthographic stages - and through the use of different strategies - logographic, phonological and lexical<sup>(9)</sup>. The Word-Pseudoword Reading Competence Test (WPRCT), the instrument chosen to assess reading competence in the present study, evaluates the development of this ability during the logographic, alphabetical and orthographic stages<sup>(10)</sup>.

The evaluation of word and pseudo-word reading is considered adequate, since the phonological path (phonological strategy) can be especially analyzed by the ability to read pseudowords, while the lexical path (lexical strategy) can be analyzed by the ability to read irregular words<sup>(11)</sup>. In addition, authors<sup>(11)</sup> stated that performance in reading tasks improves with increases in age and schooling, being automated over the school years. This is due to the fact that children gain greater experience with reading and lexical knowledge and phoneme combination structures, thus improving both reading routes<sup>(11)</sup>.

By associating reading comprehension with reading single words, it is found that as word decoding becomes a faster process, the working memory is able to devote more time to syntactic analysis tasks, to the semantic function of each element of the sentence and how the sentences are integrated in that context, thus contributing to the comprehension of the material read<sup>(12)</sup>.

In this context, several researchers have highlighted the skills contained in phonological processing as a predisposing element for reading acquisition and development, including phonological awareness, access to the lexicon and phonological working memory<sup>(13)</sup>. Phonological processing encompasses the process of using language sound information and is essential for both oral and written language<sup>(13)</sup>. Therefore, students with difficulty in this processing may have difficulty in triggering accurate visual processing, which will result in impaired phonological access, necessary for reading and writing, as phonological processing is seen as an active component in the reading-decoding and written-coding process<sup>(13)</sup>. Changes in reading fluency and

reading comprehension are usual in children with handicaps in this processing, due to deficits in phonological perception and low storage capacity of information in working memory<sup>(13)</sup>.

For this reason it is important to mention the role played by working memory, which is key in the reading process. Working memory allows to temporarily keep information in mind so that it can be manipulated by comparing, relating or contrasting it, establishing connections with long-term memory to access prior knowledge in order to provide better reading comprehension<sup>(1)</sup>. It is noteworthy that working memory plays an active role in information processing and has the following mental representation: central executive, main component responsible for maintaining attention, and concentration<sup>(13,14)</sup>. It can manage information processing and storage at the same time, while overseeing the three subcomponents<sup>(13,14)</sup>: the phonological loop, which stores verbal information<sup>(13,14)</sup>; the visuospatial system, responsible for retaining both visual and spatial information<sup>(13,14)</sup> and, finally, the episodic *buffer*, responsible for managing the retrieval of long-term memory information<sup>(14)</sup>.

Working memory has fundamental importance for good performance in phonological awareness and phoneme-grapheme association tasks, since it is necessary to retain verbal information to manipulate language structure<sup>(13,14)</sup>. Studies have shown that children with impaired phonological awareness skills also had poor working memory performance<sup>(15,16)</sup>.

Working memory is also important for language comprehension, learning and reasoning, as it allows the temporary storage and manipulation of information necessary for the performance of those complex tasks<sup>(14)</sup>.

Similarly, the processing of auditory information also plays a key role. Central auditory processing can be defined as the ability of the central nervous system to use auditory information efficiently and effectively<sup>(17)</sup> and includes sound localization and lateralization skills; hearing discrimination; hearing pattern recognition; temporal aspects of hearing, including temporal ordering; hearing performance when exposed to competitive acoustic signals (including dichotic listening) and hearing performance with degradation of acoustic signals<sup>(18)</sup>.

The present study was based on two auditory skills: 1) sound localization, defined as a binaural phenomenon, due to the interaural differences in time and intensity of the sound stimulus that reach both ears, a fact that allows the individual to determine the distance, the position and elevation of the sound source<sup>(19)</sup>; 2) temporal ordering, which is related to the processing of various auditory stimuli, in the order in which they occur<sup>(19)</sup>. Thus, it is expected that the individual is able to identify the correct order in which the sounds were presented<sup>(19)</sup>.

According to the literature<sup>(20)</sup>, auditory processing tests have often been used to verify the association between school difficulties and changes in the development of auditory skills, since the study related learning difficulties with auditory processing disorder<sup>(20)</sup>.

By understanding the relationship between poor performance in working memory and phonological awareness tasks in children with impaired hearing skills, it can be inferred that the storage and processing of language information are linked to the processing of auditory information. Furthermore, it is possible to infer that the central auditory system communicates with other mental areas, producing a “ripple effect” on the other higher systems, including working memory<sup>(14)</sup>.

A study<sup>(14)</sup> showed that children with impaired auditory abilities had worse results in the assessment of temporal

resolution, phonological awareness and working memory (including word and pseudoword decoding), which strengthens the inference of the association of central auditory processing with other mental modules<sup>(14)</sup>.

Given that reading competence and hearing skills are essential for good school development<sup>(6,20)</sup> and that there is a shortage of studies relating these skills, the present research may play an important role, aiming to provide subsidies for the development of health promotion strategies at school, in addition to fostering the understanding about the development of schoolchildren, and consequently helping to develop effective therapeutic strategies for children with difficulties in this area.

It is worth mentioning that the guiding axis of this research was the hypothesis that there is an association between reading competence and school, auditory and sociodemographic aspects. It is noteworthy that the proper development of this competence is essential in order to allow the process of learning to actually happen during the school phase.

Thus, the aim of the present study was to verify the association between words and pseudowords reading competence in schoolchildren from 7 to 10 years old confronted with the variables gender, age, school performance and hearing skills.

## METHODS

This is a cross-sectional observational analytical study, with a non-probabilistic sample, consisting of 109 students, aged 7 to 10 years, enrolled in three municipal schools in the Northern and Pampulha regions of Belo Horizonte, Minas Gerais. Of these, two are located in a health district with a medium health vulnerability index and the other in a health district with a low health vulnerability index. The study was cleared by the Research Ethics Committee of the Federal University of Minas Gerais - CEP-UFGM, under opinion CAAE 0672.0.203.000-11; and the adults responsible for all participants signed the Informed Consent Form - ICF.

The criteria for inclusion in the study were: being between 7 and 10 years old and regularly enrolled in the educational facility, regardless of whether or not they were repeating students. Exclusion criteria were: not being literate; to quit during the test application; present evidence or history of cognitive, neurological, neuropsychiatric or motor impairment; being in the process of evaluation or speech therapy; having a previous diagnosis of hearing impairment; being dismissed from the educational facility prior to the completion of the tests.

To fulfill the research objective, the following procedures were performed:

- Word-Pseudoword Reading Competence Test (WPRCT)<sup>(10)</sup>: An individual application test, evaluating the silent reading of words and pseudowords. It consists of eight training items and seven subtests with ten items each, randomly distributed throughout the test. It has 78 items, each of which is formed by a picture and a written element, which can be a word or a pseudoword. The child's task is to circle the right and appropriate words to the pictures and to mark the wrong words that are not appropriate to the pictures. For the effect of analysis, scores classified as "very low" and "low" were considered altered results, while scores classified as "medium" and "high" were considered normal results<sup>(10)</sup>.

- Test for School Achievement (TDE)<sup>(21)</sup>: assesses writing, reading and arithmetic through three subtests: writing, which assesses the child's ability to write his or her own name and isolated words; reading, which evaluates the reading of single words; arithmetic, which evaluates oral problem solving and mathematical operations. The writing subtest was applied in small groups ranging from a minimum of three children to a maximum of five. The other subtests were applied individually. The time to perform the TDE should be approximately 20 to 30 minutes, and for its completion, students receive an individual notebook containing the three subtests with items presented in increasing order of difficulty. The test can be started by any subtest and should be interrupted when the solution of a certain item is no longer possible for the child<sup>(21)</sup>.
- Assessment of auditory skills<sup>(22)</sup>: performed individually, it consists of tests that assess auditory abilities of sound localization and simple temporal ordering for verbal and nonverbal sounds. In the sound localization test, the evaluator plays the rattle in five directions (right, left, front, above, behind) and asks the child to point out which one the sound originates from. In the memory test for verbal sounds in sequence, the child is asked to repeat, as she/he hears, the three sequences in which the syllables /pa/, /ta/, /ka/, /fa/ are presented by the examiner. In the memory test for nonverbal sounds in sequence, the child is asked to point out the correct order of the three sequences in which the four instruments (bell, rattle, coco, agogô) were presented<sup>(22)</sup>. The tests are performed without visual cue.

Data collection was performed on different days, in a space provided by the school, and each session for application of the instruments lasted from 40 to 60 minutes. All procedures were performed in a room with little noise exposure, in order to avoid interference in the results.

The response variable of this study was the reading competence and as explanatory variables the sociodemographic aspects (gender, age and school year), school performance and auditory skills of sound localization and simple temporal ordering.

It is noteworthy that the number of participants varied in the applied tests, due to lost data or unfinished tests.

The collected data were typed, checked and categorized in a database. Descriptive analysis of frequency distribution of all categorical variables and analysis of central tendency and dispersion measures of continuous variables were performed. For association analyzes, Pearson's chi-square and Fisher's exact tests were used, considering as statistically significant associations those with  $p \leq 0.05$ . The school performance variable, according to the test classification criteria, presents, as a result, the options "superior", "mid" and "inferior". For analysis, these options were categorized as "mid/superior" and "inferior". For data entry and processing, the software SPSS version 20.0 was used.

## RESULTS

The sample consisted of 109 students, most of them (50.5%) male. The age range ranged from 7 years to 10 years, 11 months and 29 days, with a mean age of 8 years and one month and a median of 8 years. Regarding education, the sample was

distributed between the 1st and 4th grades of elementary school, with 1/3 attending the 1st grade (n = 34), 40%, the 2nd grade (n = 39), 16%, the 3rd year (n = 17) and 11%, the 4th year (n = 12) (Figure 1).

The Word-Pseudoword Reading Competence Test (WPRCT) was applied to 102 children, of which 14 (12.8%) presented altered result and 88 (80.7%), normal result, according to the reference criteria for age and education<sup>(13)</sup>. The median age of the children who showed both adequate and inadequate results was 8 years. The performance in the WPRCT showed great variation, according to the variables school year and age, and students from the 1st (31.4%) and 2nd (32.3%) years had the highest occurrence of adequate results, according to the reference criteria<sup>(13)</sup>. In addition, the highest percentage of changes occurred in students from the 2nd (5.9%) and 3rd (4.9%) grades (Figure 2). The higher number of adequate and

inadequate results of children in the 2nd year is explained by the fact that a large portion of the sample is attending this school year (39 children).

As for the Test for School Achievement (TDE), of the 103 students evaluated, 56 (51.4%) had lower school performance, while 47 (43.1%) had mid/superior school performance.

The Simplified Auditory Processing Test (SAPT) was applied to 103 students and showed that approximately 2/3 of the children had adequate hearing localization skills (90.9%) and simple temporal ordering for verbal sounds (52.1%) and nonverbal sounds (65.3%) in sequence. It is noteworthy that the percentage of adequate results in the test that assesses the sound localization ability was considerably higher when compared to the percentage of adequate results in the tests that assess the simple temporal ordering ability.

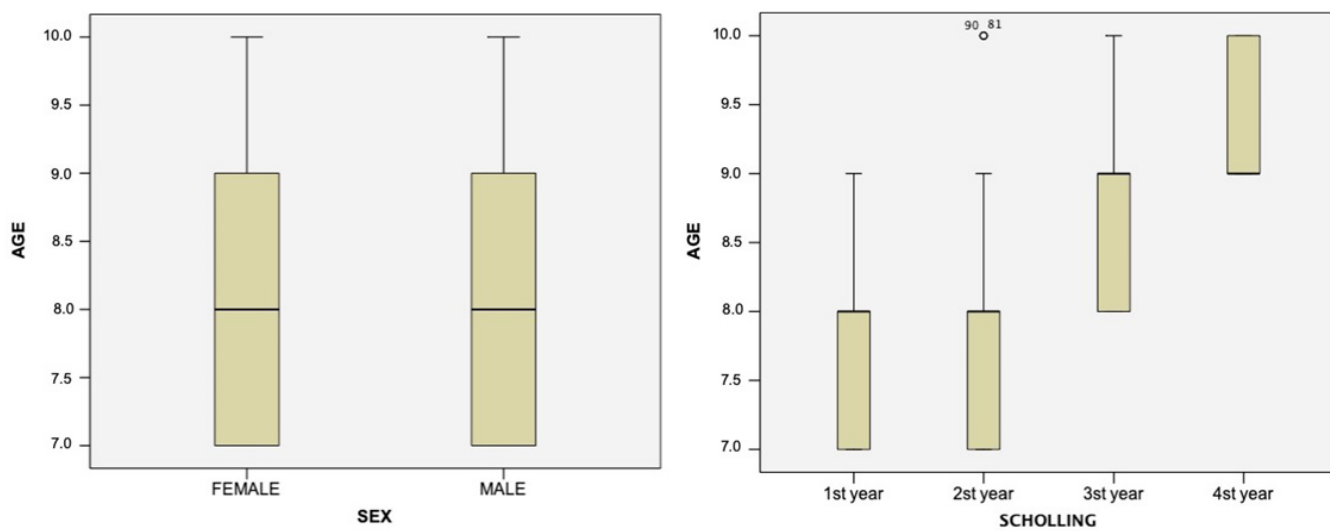


Figure 1. Boxplot of distribution by age and sex; age and schooling grade

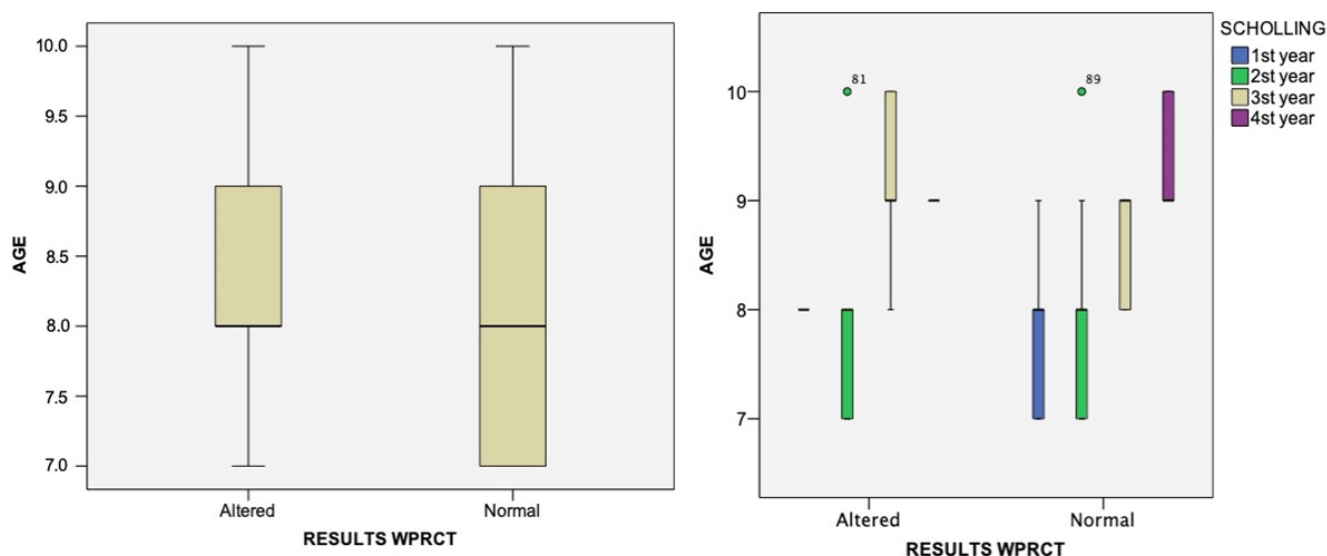


Figure 2. Boxplot of the distribution of results of the Word-Pseudoword Reading Competence Test



Although no association was statistically significant, it was observed that students with adequate results in the three tests of the Simplified Auditory Processing Test also presented results compatible with the normality criteria in the WPRCT (Table 1).

The distribution of students with normal performance in WPRCT, regarding gender, was similar, with the number of girls (n = 47) slightly higher than boys (n = 41). Students enrolled in the 1st year (n = 32) and the 2nd year (n = 33) of elementary school presented the best performance in the

WPRCT, when compared to the students of the 3rd and 4th years. However, such associations were not statistically significant (Table 2).

There was statistical significance between the results of the WPRCT and the variables overall TDE, Writing TDE, Arithmetic TDE and Reading TDE. Thus, it was found that children with normal performance in WPRCT tend to have a mid/superior school performance in the overall TDE classification as well as in each of the three subtests that compose it.

**Table 1.** Association between the results of the Word-Pseudoword Reading Competence Test and auditory skills for sound localization ability and simple temporal ordering

| Variables | WPRCT        |    |        |    | p-Value |        |
|-----------|--------------|----|--------|----|---------|--------|
|           | Altered      |    | Normal |    |         |        |
|           | n            | %  | n      | %  |         |        |
| SMNV      | Adequate     | 6  | 6.1    | 58 | 59.2    | 0.11*  |
|           | Non-adequate | 7  | 7.1    | 27 | 27.6    |        |
|           | Total        | 13 | 13.2   | 85 | 86.8    |        |
| SMV       | Adequate     | 5  | 5.1    | 46 | 47      | 0.30*  |
|           | Non-adequate | 8  | 8.1    | 39 | 39.8    |        |
|           | Total        | 13 | 13.2   | 85 | 86.8    |        |
| SL        | Adequate     | 11 | 11.2   | 78 | 79.7    | 0.44** |
|           | Non-adequate | 2  | 2      | 7  | 7.1     |        |
|           | Total        | 13 | 13.2   | 85 | 86.8    |        |

\*Chi-Square Test; \*\*Fisher's Exact Test

**Captions:** SMNV = Sequential Memory Test for Non-verbal Sounds; SMV = Sequential Memory Test for Verbal Sounds; SL = Sound Localization Test; WPRCT = Word-Pseudoword Reading Competence Test; n = number of students

**Table 2.** Association between the results of the Word-Pseudoword Reading Competence Test and socio-demographic variables and the Test for School Achievement

| Variables      | WPRCT                           |    |        |    | p-Value |          |
|----------------|---------------------------------|----|--------|----|---------|----------|
|                | Altered                         |    | Normal |    |         |          |
|                | n                               | %  | n      | %  |         |          |
| Sex            | Feminine                        | 5  | 4.9    | 47 | 46.1    | 0.22*    |
|                | Masculine                       | 9  | 8.8    | 41 | 40.2    |          |
|                | Total                           | 14 | 13.7   | 88 | 86.3    |          |
| Schooling      | 1st year                        | 2  | 2      | 32 | 31.4    | 0.13*    |
|                | 2nd year                        | 6  | 5.9    | 33 | 32.3    |          |
|                | 3rd year                        | 5  | 4.9    | 12 | 11.8    |          |
|                | 4th year                        | 1  | 0.9    | 11 | 10.8    |          |
|                | Total                           | 14 | 13.7   | 88 | 86.3    |          |
| Overall TSA    | Lower School performance        | 13 | 13     | 40 | 40      | <0.001** |
|                | Mid-superior School performance | 0  | 0      | 47 | 47      |          |
|                | Total                           | 13 | 13     | 87 | 87      |          |
| Written TSA    | Lower School performance        | 13 | 13     | 41 | 41      | <0.001** |
|                | Mid-superior School performance | 0  | 0      | 46 | 46      |          |
|                | Total                           | 13 | 13     | 87 | 87      |          |
| Arithmetic TSA | Lower School performance        | 12 | 12     | 33 | 33      | <0.001** |
|                | Mid-superior School performance | 1  | 1      | 54 | 54      |          |
|                | Total                           | 13 | 13     | 87 | 87      |          |
| Reading TSA    | Lower School performance        | 13 | 13     | 37 | 37      | <0.001** |
|                | Mid-superior School performance | 0  | 0      | 50 | 50      |          |
|                | Total                           | 13 | 13     | 87 | 87      |          |

\* Chi-Square Test; \*\* Fisher's Exact Test

**Captions:** WPRCT = Word-Pseudoword Reading Competence Test; TSA = Test for School Achievement; n = number of students

## DISCUSSION

This study was conducted in three municipal schools in the Northern and Pampulha regions of Belo Horizonte, Minas Gerais. The students participating in the assessment belonged to the age group 7-10 years and were enrolled from the first to the fourth year of elementary school. Most participants were male and in the second grade, being the age of 8 years most frequent.

Regarding WPRCT, the results considered adequate, according to the reference criteria<sup>(10)</sup>, were concentrated in students from the first and second year. This finding differs from that found in other studies<sup>(10,23)</sup>, which demonstrated an improvement in student performance with increasing schooling.

It is worth mentioning an important result found in this study, which showed that more than half of the sample had lower school performance, which may have influenced the performance of children in WPRCT. It is worth considering that, despite the results, all students enrolled from the first to the fourth year were invited to participate in the research. Therefore, this relevant finding reflects the profile characterization of the studied sample.

In the analysis of the association of WPRCT results with age, the data found in this study, although not statistically significant, concur with the literature<sup>(10)</sup>, showing better results in the performance of students aged 7 to 8 years while worse results appear in 9-year-old schoolchildren. Although it is expected to improve the use of these routes as age and education progress<sup>(11)</sup>, this data can be explained by the difficulty of 9-year-old students with the use of reading routes, reflecting the sample profile of the present research. However, this finding merit to be further investigated in future research. It is noteworthy that the study<sup>(10)</sup> that presented the validation of the WPRCT evaluated students from the first to the third grade of elementary school, corresponding to the students enrolled up to the fourth year of elementary school in the nine-year regime.

In the association between the results of the WPRCT and the auditory skills of location and simple temporal ordering, it was found that more than two thirds of the students with adequate results in the auditory processing tests also presented normal results in the WPRCT. Despite the lack of statistical significance, this finding confirms other reports in the literature<sup>(24)</sup>, since changes in hearing skills are often related to difficulties in reading, writing and learning<sup>(24)</sup>.

The auditory ability of sound localization, important for the development of spatial perception and selective attention<sup>(25)</sup>, was the item that presented the best results considering all the evaluated students, in accordance with what was also demonstrated by other research<sup>(25,26)</sup>.

Regarding the tests that evaluate the auditory ability of simple temporal ordering, it is worth mentioning that almost half of the students presented inadequacy in the Sequential Memory Test for Verbal Sounds and more than one third of the students presented inadequacy in the Sequential Memory Test for Non-verbal Sounds, showing a significant number of changes in the auditory ability of simple temporal ordering. This findings agree with data shown by other authors<sup>(27)</sup>, who also found a large proportion of students with inadequacy in the above tests. Thus, when considering the importance of such skills in language development, it is necessary to think about strategies to prevent hearing impairment in this population.

In students who presented alterations in WPRCT, it was also found the inadequacy of the simple temporal ordering ability, which is related to the ability to recognize, identify and order acoustic stimuli during a given period, according to the order in which they were presented<sup>(27)</sup>. Other studies<sup>(27-29)</sup> have verified the association between reading and temporal auditory processing. Since this auditory ability is essential for speech and language comprehension, its inadequacy may derive in orthographic difficulties and hindrance in the coding/decoding of both words and phrases<sup>(27,29)</sup>.

The presence of results with statistical significance between the overall TDE, its subtests and the WPRCT indicates that reading competency is related to school performance. Considering that reading stands out as an important means of knowledge acquisition<sup>(6)</sup>, it can be seen its importance throughout the school development process<sup>(12)</sup>.

A study<sup>(23)</sup> that correlated reading strategies assessed through the WPRCT with school grades evidenced the importance of reading strategies in the academic performance of students. This study demonstrated the evolution of the reading strategies used by the students and their consequent evolution in the reading ability, from the logographic strategy until reaching the orthographic or lexical strategy<sup>(23)</sup>. This gradual development is crucial, since difficulties in reading ability can compromise the entire learning process, therefore interfering with school development<sup>(12)</sup>.

Reading is closely related to writing, as both require being skilled regarding the phoneme-grapheme and grapheme-phoneme encoding and decoding process<sup>(12)</sup>. Thus, difficulties in reading and writing skills may end up lowering the school performance<sup>(30)</sup>.

It is also possible to affirm that the reading ability works as a feedback factor, contributing to the learning process of several school contents, being mathematics one among them<sup>(30)</sup>. For this reason this ability becomes a facilitator for the use of complex cognitive processes, such as analogical and analytical reasoning, that is needed for example, for learning arithmetic<sup>(30)</sup>.

It is important to point out that, although the isolated analysis of words and pseudowords was not performed, the chosen test (Word and Pseudo-word Reading Competence Test) reflects in its final score the score of both categories.

The findings of the present study constitute a breakthrough as they discuss the association of reading competency tasks with auditory skills and school performance. Thus, it is noteworthy that this research may open the way for furthering studies in this area, in order to be used for health promotion in the school environment, as well as for the improvement of interventions in children with school issues.

Notwithstanding the abovementioned advances, some limitations are worth of consideration. Among them, the fact that the sample was non-probabilistic and selected students from only three public education institutions, which did not allow to extrapolate the results to another contexts. In addition, the non-equivalence of the distribution of subjects in the age and education groups made it impossible to perform other analyzes and associations among the dataset.

In addition, the use of other instruments with more robust samples should be performed for further investigation. The use of other tests to assess auditory processing and reading competence is proposed, since the simplified assessment performed in this study did not show statistically significant results when associated with reading competence, and the WPRCT indicated weak results in pre-teens.

Future research with population studies and adjustment of the instruments is necessary, in view of the purpose of incorporating the results into speech, language and hearing sciences, as well as in educational practice.

## CONCLUSION

The study revealed an association with statistical significance between reading competence in words/pseudowords and school performance of children aged from 7 to 10 years, 11 months and 29 days, indicating the importance of reading ability in the academic performance of students. However, there was no evidence of a statistically significant association between words/pseudowords competence, sociodemographic variables and auditory skills (simple temporal ordering and sound localization).

## REFERENCES

- Vieiro P, Amboage I. Relación entre habilidades de lectura de palabras y comprensión lectora. *Rev de Investigación en Logopedia*. 2016;1:1-21.
- Machado AC, Capellini AS. Caracterização do desempenho de crianças com distúrbio de aprendizagem em estratégias de compreensão leitora. *Rev Psicop*. 2011;28(86):126-32.
- Carrilho APN. Relação entre compreensão leitora e habilidades cognitivas e linguísticas em escolares com Distúrbio de Aprendizagem [tese de doutorado]. Bauru (SP): Universidade de São Paulo; 2016. <http://dx.doi.org/10.11606/T.25.2016.tde-08082016-220203>.
- Bovo EBP, Lima RF, Silva FCP, Ciasca SM. Relações entre as funções executivas, fluência e compreensão leitora em escolares com dificuldades de aprendizagem. *Rev Psicopedagogia*. 2016;33(102):272-82.
- Uvo MFC, Germano GD, Capellini SA. Desempenho de escolares com transtorno do déficit de atenção com hiperatividade em habilidades metalinguísticas, leitura e compreensão leitora. *Rev CEFAC*. 2017;19(1):7-19. <http://dx.doi.org/10.1590/1982-0216201719115815>.
- Lobo Pd'AS. Avaliação da competência de leitura silenciosa para palavras escritas, em escolares com e sem Transtorno de Déficit de Atenção/Hiperatividade – TDA/H [tese de doutorado]. Brasília: Universidade de Brasília; 2008.
- Passaglio NJS, Souza MA, Lemos SMA. Vocabulário receptivo em escolares: fatores associados [trabalho de conclusão de curso]. Belo Horizonte: Universidade Federal de Minas Gerais, Faculdade de Medicina, Curso de Fonoaudiologia; 2014.
- Knijnik LF, Giacomoni C, Stein LM. Teste de Desempenho Escolar: um estudo de levantamento. *Rev Psico-USF*. 2013;18(3):407-16. <http://dx.doi.org/10.1590/S1413-82712013000300007>.
- Frith U. *Dyslexia as a developmental disorder of language*. London: MRC, Cognitive Development Unit; 1990.
- Capovilla FC, Varanda C, Capovilla AGS. Teste de competência de leitura de palavras e pseudopalavras: normatização e validação. *Rev Psicol*. 2006;7(2):47-59.
- Salles JF, Piccolo LR, Zamo RS, Toazza R. Normas de desempenho em tarefa de leitura de palavras/pseudopalavras isoladas (LPI) para crianças de 1º ano a 7º ano. *Estud Pesqui Psicol*. 2013;13(2):397-419.
- Cunha VLO, Oliveira AM, Capellini AS. Compreensão de Leitura: princípios avaliativos e interventivos no contexto educacional. *Rev Teias*. 2010;11(23):221-40.
- Gonçalves-Guedim TF, Capelatto IV, Salgado-Azoni CA, Ciasca SM, Crenitte PAP. Desempenho do processamento fonológico, leitura e escrita em escolares com transtorno de déficit de atenção e hiperatividade. *Rev CEFAC*. 2017;19(2):242-52. <http://dx.doi.org/10.1590/1982-0216201719220815>.
- Pires MM, Mota MB, Pinheiro MMC. Os sistemas de memória de crianças portadoras do distúrbio do processamento auditivo (central). *CoDAS*. 2015;27(4):326-32. <http://dx.doi.org/10.1590/2317-1782/20152015018>. PMID:26398254.
- Capellini SA, Padula NAMR, Santos LCA, Lourenceti MD, Carrenho EH, Ribeiro LA. Desempenho em consciência fonológica, memória operacional, leitura e escrita na dislexia familiar. *Pró-Fono R Atual Cient*. 2007;19(4):374-80. <http://dx.doi.org/10.1590/S0104-56872007000400009>.
- Mainela-Arnold E, Misra M, Miller C, Poll GH, Park S. Investing sentence processing and language segmentation in explaining children's performance on a sentence-span task. *Int J Lang Commun Disord*. 2012;47(2):166-75. <http://dx.doi.org/10.1111/j.1460-6984.2011.00080.x>. PMID:22369057.
- ASHA: American Speech-Language-Hearing Association. (Central) Auditory Processing Disorders [Internet]. Rockville: ASHA; 2005 [citado em 22 Nov 2015]. Disponível em: <http://www.asha.org/policy/TR2005-00043.htm>
- Prando ML, Pawlowski J, Fachel JMG, Misorelli MIL, Fonseca RP. Relação entre habilidades de processamento auditivo e funções neuropsicológicas em adolescentes. *Rev CEFAC*. 2010;12(4):646-61. <http://dx.doi.org/10.1590/S1516-18462010005000027>.
- Nishihata R, Vieira MR, Pereira LD, Chiari BM. Processamento temporal, localização e fechamento auditivo em portadores de perda auditiva unilateral. *Rev Soc Bras Fonoaudiol*. 2012;17(3):266-73. <http://dx.doi.org/10.1590/S1516-80342012000300006>.
- Neves IF, Schochat E. Maturação do processamento auditivo em crianças com e sem dificuldades escolares. *Pró-Fono Rev Atual Cient*. 2005;17(3):311-20. <http://dx.doi.org/10.1590/S0104-56872005000300005>.
- Stein LM. *TDE: Teste de Desempenho Escolar: manual para a aplicação e interpretação*. São Paulo. Casa do Psicólogo; 1994.
- Schochat E, Pereira LD. *Testes auditivos comportamentais para avaliação do processamento auditivo central*. 1a ed. São Paulo: Pro Fono; 2011.
- Capovilla AGS, Dias NM. Desenvolvimento de estratégias de leitura no ensino fundamental e correlação com nota escolar. *Psicol Rev*. 2007;13(2):363-82.
- Amaral MI, Martins PM, Colella-Santos MF. Temporal resolution: assessment procedures and parameters for school-aged children. *Rev Bras Otorrinolaringol*. 2013;79(3):317-24. <http://dx.doi.org/10.5935/1808-8694.20130057>. PMID:23743747.
- Frota S, Pereira LD. Processamento auditivo: estudo em crianças com distúrbios da leitura e da escrita. *Rev. Psicop*. 2010;27(83):214-22.
- Santos JN, Lemos SMA, Rates SPM, Lamounier JA. Habilidades auditivas e desenvolvimento de linguagem em crianças. *Pró-Fono Rev de Atual Cient*. 2008;20(4):255-60. <http://dx.doi.org/10.1590/S0104-56872008000400009>.
- Rezende BA, Lemos SMA, Medeiros AM. Aspectos temporais auditivos de crianças com mau desempenho escolar e fatores associados. *CoDAS*. 2016;28(3):226-33. <http://dx.doi.org/10.1590/2317-1782/20162015170>. PMID:27462731.

28. Simões MB, Schochat E. Transtorno do processamento auditivo (central) em indivíduos com e sem dislexia. *Pró-Fono Rev de Atual Cient.* 2010;22(4):521-4. <http://dx.doi.org/10.1590/S0104-56872010000400027>.
29. Mourão AM, Esteves CC, Labanca L, Lemos SMA. Desempenho de crianças e adolescentes em tarefas envolvendo habilidade auditiva de ordenação temporal simples. *Rev CEFAC.* 2012;14(4):659-68. <http://dx.doi.org/10.1590/S1516-18462011005000141>.
30. Oliveira KL, Boruchovitch E, Santos AAA. Leitura e desempenho escolar em português e matemática no ensino fundamental. *Paidéia.* 2008;18(41):531-40.