COGNITIVE-LINGUISTIC SKILLS AND THEIR RELATIONSHIP WITH RESPIRATORY CHARACTERISTICS

Habilidades cognitivo-linguísticas e sua relação com características respiratórias

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ABSTRACT

Purpose: to relate respiratory characteristics with cognitive-linguistic skills performance of children from a public school of the region of Belo Horizonte. **Method:** a cross-sectional, observational and descriptive study. From the 180 enrolled children, 131 met the inclusion and exclusion criteria. We evaluated 66 children in the 4th grade and 65 children in the 3rd grade of the elementary education, from both genders, with ages going between nine and ten year old. We utilized a questionnaire for assessment of respiratory characteristics and a previously published protocol and adapted to the Brazilian population in order to assess the cognitive-linguistic skills. Data were analyzed using the Mann-Whitney and Kruskal Wallis test at a significance level of 1%. **Results:** there was not observed a p-value <0.01 in comparison between the respiratory characteristics and the cognitive-linguistic skills' score obtained by each series. We observed that 59.1% of students had scores in a questionnaire for assessment of respiratory characteristics between zero and four points, indicating some impairment in respiratory variables studied. We obtained a significant p value for comparisons between the performance in cognitive-linguistic skills and the presence of respiratory disorders in the studied series. **Conclusion:** no significant relationship was found between the performance of cognitive-linguistic skills and the presence of respiratory characteristics in students from the same public school of Belo Horizonte city, and the children who showed respiratory changes didn´t have performance below those without these changes in the assessed skills.

KEYWORDS: Learning; Education Status; Learning Disorders; Mouth Breathing

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INTRODUCTION

Among the most common respiratory disorders, especially among students, there is mouth breathing. Being considered a pathological adaptation to the difficulty of breathing through the nose, mouth breathing prevents the heating, humidification and filtration of air that reaches the lungs[1].

The most frequent etiologies related to oral breathing is obstructive and/or pharyngeal nasal. The decrease in strength of the orofacial muscles can also lead to lack of labial sealing, and may cause a functional mouth breathing (when there is no mechanical obstruction)[2].

There are numerous features that accompany mouth breathing, leading to the need for a multidisciplinary care to patients diagnosed with this

disorder[3]. Among these changes it is described postural problems[4, 5], allergic conditions, olfaction[6, 7], snoring and sleep disorders[8]. Other effects commonly reported in studies involving oral breathing children is the presence of deleterious oral habits[9], orthodontic changes and orofacial structures such as the tongue and lips[10].

During sleep breathing discomfort is increased in the mouth-breathing children. In children with apnea sleep all the sleep cycle is altered. During the day, they can present aggressive behavior, symptoms of hyperactivity, attention deficit and cognitive and intellectual problems that will interfere in school learning[11]. In a study in which we assessed the problems related to sleep-disordered breathing, mouth breathing was one of the most common disorders[12].

According to some authors respiratory disorders in children can lead to impaired growth, neurocognitive deficits, and less frequently, cardiovascular changes[13]. It is described in the literature that patients with nocturnal respiratory disorders may show a decrease in cerebral vascular flow during episodes of apnea[14]. Researchers also show that the most severe respiratory changes presented both in children and in adults is obstructive sleep apnea, where individuals have difficulties in cognitive functions reflecting negatively on life quality[15].

The complaint of parents of mouth breathing children having difficulties in school is also common. A study through questionnaires to parents and teachers, found that sleep disorders lead to inattention, hyperactivity, impulsivity, and naps during class. Among children who had changes in the assessed skills, most of them also presented oral breathing[16]. However, in a study in which children were assessed in a social project in the state of Pernambuco it was not found a significant association between respiratory pattern and behavioral changes such as hyperactivity or inattention[17].

Learning is a complex process that requires children to use phonological components, syntactic and semantic of the language[18]. For the child to go through the school process, a series of abilities and skills should necessarily be previously acquired or developed[19]. In the comparison between the performance of children with respiratory disorders and those that do not express these complaints, it is observed that the first group presents greater difficulties in performing phonological awareness skills, these skills are precursors of a good development of reading and writing [20.21].

Changes introduced as a result of installation or permanence of a respiratory disturbance framework lead to health problems, facial growth and behavioral changes can also affect student learning[22]. It is described in the literature that respiratory changes are common in school-aged children and which highly complex skills are precursors of the learning process.

Thus, the aim of this study was to assess the cognitive-linguistic skills of children from a public school in Belo Horizonte and relate the performance of these skills with respiratory characteristics of the students.

METHOD

This work is characterized as a transversal, observational and descriptive study.

Sample

For this study it was assessed children of both genders, aged from nine to ten, from 4th and 3rd grade of elementary school, 5th and 4th school year, respectively. All children were from the same public school in the city of Belo Horizonte, Minas Gerais.

It was considered as exclusion criteria children who had any syndromic and/or neurological change as well as sensory changes such as auditory and/or visual damage. For inclusion, parents or guardians should respond to the Questionnaire for Assessment of Respiratory Characteristics (QARC) (Figure 1) and signing the informed consent form (ICF) agreeing with the participation of their child in the study.

QUESTIONNAIRE FOR ASSESSMENT OF RESPIRATORY CHARACTERISTICS – QARC
(Wagnitz, Tanaka, 2001)

SCHOOL: _____GRADE:_____
STUDENT'S NAME: _____
DATE OF BIRTH: _____/_____/_____ Age: _____years _____ months old

1. Does your kid have or has she/ he ever had any allergy?	( ) NO	( ) YES
2. Does your kid have or has she/ he ever had any allergy to any specific medicine?	( ) NO	( ) YES
3. Is your kid or has she/ he ever been in a treatment for allergies?	( ) NO	( ) YES
4. Does your kid have or has she/ he ever had rhinitis?	( ) NO	( ) YES
5. Does your kid have or has she/ he have frequent headaches?	( ) NO	( ) YES
6. Does your kid have or has she/ he have frequent flues?	( ) NO	( ) YES
7. Does your kid have or has she/ he have frequent sore throat?	( ) NO	( ) YES
8. Does your kid have a smelly mouth (halitosis)?	( ) NO	( ) YES
9. When your kid wakes up, is she/he thirsty, does she/he present with dry mouth?	( ) NO	( ) YES
10. Does your kid have or has she/ he ever had any pain in the ear (otitis)?	( ) NO	( ) YES
11. Does your kid have or has she/ he ever had difficulty hearing?	( ) NO	( ) YES
12. Does your kid have difficulty in sleeping?	( ) NO	( ) YES
13. Does your kid have little sleep?	( ) NO	( ) YES, how many hours a day?
14. Does your kid snore while sleeping?	( ) NO	( ) YES
15. Does your kid drool on the pillow while sleeping?	( ) NO	( ) YES
16. Does your kid breathe through the mouth during the day?	( ) NO	( ) YES
17. Does your kid breathe through the mouth during the night?	( ) NO	( ) YES
18. Does your kid present difficulty chewing?	( ) NO	( ) YES
19. Does your kid present difficulty swallowing?	( ) NO	( ) YES
20. Has your kid been hospitalized?	( ) NO	( ) YES, why?
21. Has your kid undergone adenoid surgery?	( ) NO	( ) YES
22. Has your kid undergone tonsils surgery?	( ) NO	( ) SIM

Restricted to researchers (PARENTS, PLEASE **DO NOT** ANSWER THE QUESTION BELOW):

23. Lack of labial sealing (5 minutes observation)?	( ) NO	( ) YES

Figure 1 – Questionnaire administered to the parents of the children participating in the study

At first the researchers approached the children participating in the study in their respective classroom, with the consent of the coordination of the school and the teacher. The objectives and methodology of the research were explained, and at the end, 180 children from the 4th and 3rd grade were given a consent form and QARC to take and present to their parents. Every classroom which had students in the 4th and 3rd grade was included in this research.

After two days from the delivery of the forms, the researchers returned to the school for the application of Protocol of Cogntivo-Linguistic Skills (PCLS) in those children who had signed the consent form and the QARC answered by parents or guardians.

Out of the 180 children invited 131 met the inclusion and exclusion criteria of this study. Thus, the sample consisted of 66 children in the 4th grade and 65 children who were in 3rd grade of elementary school.

Questionnaire for Assessment of Respiratory Characteristics (QARC)

Importantly, in this study we investigated possible signs and symptoms of oral and nasal breathing children. The participants were not classified as oral or nasal breathers, since obtaining this diagnosis must necessarily be carried out by a multidisciplinary team. To obtain information regarding respiratory characteristics of each student, a questionnaire was proposed in the literature[23]. The questionnaire consists of 22 closed questions, which were answered by parents or guardians. The responses were stored in a database and then compared with the scores obtained in PHCL.

It was also evaluated the usual position of the lips, by observing the child for five minutes on a distracting task. The observation of lip closure was performed individually for each child during the application of PHCL by two different researchers from the one responsible for the direction of the application of the test. The presence or absence of labial sealing was recorded in the QARC for subsequent statistical analysis.

Protocol of Assessment of Cognitive Linguistics Skills (PHCL)

To evaluate the performance of the cognitive--linguistic skills of the students who participated in this research, it was used the Protocol of Assessment of Cognitive Linguistics Skills (PHCL) – collective version, Brazilian adaptation[24].

The application of tests was performed in quiet rooms, under the direction of an applicator and supervision of other two applicators, following guidelines of the protocol itself. The test version used is composed of five parts: recognition of the alphabet in sequence, copy forms, writing under dictation, arithmetic and short-term memory. One point was scored for each correct answer on the test.

To facilitate statistical analysis the scores were divided into areas:

- **Alphabet:** Alphabet Recognition (maximum score: 26)
- **Copy:** Copy figures (maximum score: 4)
- **Words dictation**: Written words in Brazilian Portuguese (maximum score: 30)
- **Pseudowords dictation**: Writing invented words (maximum score: 10)
- **Total dictation**: Sum between the points obtained in the spelling of words and pseudowords (maximum score: 40)
- **Math:** Arithmetic (maximum score: 20)
- **Memory:** short term memory (maximum score: 14)
- **Total score:** Sum of scores in all skills (maximum score: 104)

This study was approved by the Ethics and Research of the Federal University of Minas Gerais under number 0012.0.203.000-10.

Statistical analysis

The collected data were entered into a structured database in Excel ® and analyzed using the PASW Statistics 18 statistical program. The descriptive results were obtained using frequency distribution for the characteristics of the various categorical variables and obtaining measures of central tendency (average and median) and measures of dispersion (standard deviation) for quantitative.

For comparison between measurements scores (alphabet, copying, word dictation, pseudowords dictation, math, memory and total score), according to the grade level, we used the Mann-Whitney nonparametric test and compared following the questionnaire score (number of questions “yes”) was employed the Kruskal Wallis non-parametric test, since the data is not normally distributed. It was established as $p < 0.01$ for statistically significant correlations.

RESULTS

Table 1 describes the comparison between the scores obtained at PHCL according to the school grade. In this you can see the comparison between the scores obtained in each area surveyed and the total score. There was a significant difference ($p < 0.01$) in scores between the grades in mathematical domains, dictation of words and total score.

Table 1 – Descriptive statistics of scores according to the grade of study

		N	Average	SD	Minimum	Q1	Median	Q3	Maximum	p-value[1]
Alphabet	4th grade	66	25,0	1,5	19,0	24,0	26,0	26,0	26,0	0,330
	3rd grade	65	24,6	2,3	15,0	24,0	25,0	26,0	26,0	
	Total	*131*	*24,8*	*2,0*	*15,0*	*24,0*	*26,0*	*26,0*	*26,0*	
Figure coping	4th grade	66	8,6	1,6	4,0	7,0	9,0	10,0	10,0	0,013
	3rd grade	65	7,9	1,9	0,0	7,0	9,0	9,0	9,0	
	total	*131*	*8,2*	*1,8*	*0,0*	*7,0*	*9,0*	*10,0*	*10,0*	
Math	4th grade	66	13,4	4,9	3,0	10,0	15,0	17,0	20,0	**<0,001**
	3rd grade	65	10,7	4,1	1,0	8,0	11,0	14,0	20,0	
	total	*131*	*12,1*	*4,7*	*1,0*	*9,0*	*13,0*	*16,0*	*20,0*	
Word dictation	4th grade	66	22,6	4,2	7,0	21,0	24,0	25,0	29,0	**0,008**
	3rd grade	65	21,1	3,9	11,0	18,0	21,0	24,0	29,0	
	total	*131*	*21,8*	*4,1*	*7,0*	*20,0*	*23,0*	*25,0*	*29,0*	
Pseudo words dictation	4th grade	66	5,3	1,9	0,0	4,0	5,0	7,0	9,0	0,929
	3rd grade	65	5,4	1,7	2,0	4,0	5,0	7,0	8,0	
	total	*131*	*5,3*	*1,8*	*0,0*	*4,0*	*5,0*	*7,0*	*9,0*	
Total dictation	4th grade	66	27,8	5,8	7,0	26,0	29,0	32,0	36,0	0,052
	3rd grade	65	26,4	4,9	13,0	23,0	27,0	29,0	37,0	
	total	*131*	*27,2*	*5,4*	*7,0*	*24,0*	*28,0*	*31,0*	*37,0*	
Memory	4th grade	66	7,5	1,7	4,0	7,0	8,0	9,0	10,0	0,115
	3rd grade	65	7,0	1,7	3,0	6,0	7,0	8,0	11,0	
	total	*131*	7,3	1,7	3,0	6,0	7,0	8,0	11,0	
Total score	4th grade	66	82,3	11,5	49,0	74,0	86,0	91,0	100,0	**<0,001**
	3rd grade	65	76,7	9,5	55,0	69,0	79,0	84,0	92,0	
	total	*131*	*79,5*	*10,9*	*49,0*	*72,0*	*81,0*	*88,0*	*100,0*	

Legend: SD-standard deviation; Q1 – first quartile, Q3 – third quartile; [1] Mann-Whitney non-parametric test.

Table 2 presents a descriptive frequency distribution found in QARC according to the school grade and the total sample.

The comparative analysis between the scores obtained in the PHCL and the respiratory characteristics obtained by QACR was performed separately for each grade. Tables 3 and 4 show, respectively for 4th and 3rd grades, the comparison between the total score on PHCL and frequency of occurrence of each variable studied in QARC. In none of the variables questioned in QACR it was observed the p-value <0.01 when compared to the total score obtained by each grade.

In order to compare the prevalence of respiratory characteristics with the scores of the evaluated grades, there was the grouping of signs and symptoms reported in QACR, and for each sign/symptom present it is assigned a point. In this way it was possible to compare the scores obtained in QACR with the PHCL scores. Figure 2 shows the distribution of frequency of the scores on the questionnaire, by grade, and the minimum score obtained was zero and the maximum score 16 (21 questions). It was observed that 59.1% of the QARC had scores between zero and four points, indicating little impairment in respiratory variables studied.

Finally, Tables 5 and 6 show, respectively for 4th and 3rd grades, the comparison between the scores obtained in QACR and the scores obtained in PHCL. The analysis was performed taking into account the quartiles from the QACR scores and the searched areas. It was not obtained significant p value for the comparisons made in the studied grades.

Table 2 – Distribution of Frequencies of respiratory changes

Respiratory Characteristic	4th grade		3rd grade		Total	
	n	%	n	%	n	%
Allergy						
Yes	20	30,3	0	0	20	15,3
No	46	69,7	65	100,0	111	84,7
Allergy to any medicine						
Yes	7	10,6	7	10,8	14	10,7
No	59	89,4	58	89,2	117	89,3
Allergy treatment						
Yes	11	16,7	14	21,5	25	19,1
No	55	83,3	51	78,5	106	80,9
Rhinitis						
Yes	23	34,8	24	36,9	47	35,9
No	43	65,2	41	63,1	84	64,1
Frequent headaches						
Yes	24	36,4	21	32,3	45	34,4
No	42	63,6	44	67,7	86	65,6
Frequent flues						
Yes	23	34,8	19	29,2	42	32,1
No	43	65,2	46	70,8	89	67,9
Frequent sore throat						
Yes	17	25,8	20	30,8	37	28,2
No	49	74,2	45	69,2	94	71,8
Smelly mouth						
Yes	12	18,2	16	24,6	28	21,4
No	54	81,8	49	75,4	103	78,6
Thirst when waking up (dry mouth)						
Yes	8	12,1	15	23,1	23	17,6
No	58	87,9	50	76,9	108	82,4
Ear pains						
Yes	22	33,3	18	27,7	40	30,5
No	44	66,7	47	72,3	91	69,5
Difficulty in hearing						
Yes	4	6,1	7	10,8	11	8,4
No	62	93,9	58	89,2	120	91,6
Difficulty in sleeping						
Yes	6	9,1	7	10,8	13	9,9
No	60	90,9	58	89,2	118	90,1
Sleeps little						
Yes	7	10,6	4	6,2	11	8,4
No	59	89,4	61	93,8	120	91,6
Snores when sleeping						
Yes	22	33,3	16	24,6	38	29,0
No	44	66,7	49	75,4	93	71,0
Drools on the pillow						
Yes	20	30,3	25	38,5	45	34,4
No	46	69,7	40	61,5	86	65,6
Breath through the mouth (Day)						
Yes	10	15,2	8	12,3	18	13,7
No	56	84,8	57	87,7	113	86,3
Breath through the mouth (Night)						
Yes	26	39,4	25	38,5	51	38,9
No	40	60,6	40	61,5	80	61,1
Difficulty chewing						
Yes	7	10,6	7	10,8	14	10,7
No	59	89,4	58	89,2	117	89,3
Difficulty swallowing						
Yes	2	3,0	1	1,5	3	2,3
No	64	97,0	64	98,5	128	97,7
Been hospitalized						
Yes	12	18,2	21	32,3	33	25,2
No	54	81,8	44	67,7	98	74,8
Undergone adenoid surgery						
Yes	6	9,1	5	7,7	11	8,4
No	60	90,9	60	92,3	120	91,6
Undergone tonsils surgery						
Yes	2	3,0	3	4,6	5	3,8
No	64	97,0	62	95,4	126	96,2
Lack of labial sealing						
Yes	11	16,7	24	36,9	35	26,7
No	55	83,3	41	63,1	96	73,3

Table 3 – Total score of 4th grade according to the questionnaire answers

		N	Average	SD	Minumum	Q1	Median	Q3	Maximum	p-value[1]
Allergy	Yes	20	83,1	11,7	55,0	80,0	87,0	90,0	97,0	0,748
	No	46	81,9	11,5	49,0	72,0	85,5	91,0	100,0	
Allergy to any medicine	Yes	7	82,0	9,2	69,0	72,0	87,0	87,0	94,0	0,684
	No	59	82,3	11,8	49,0	74,0	86,0	91,0	100,0	
Allergy treatment	Yes	11	84,8	9,4	68,0	78,0	87,0	91,0	97,0	0,552
	No	55	81,7	11,9	49,0	74,0	85,0	91,0	100,0	
Rhinitis	Yes	23	85,7	8,6	68,0	79,0	87,0	93,0	97,0	0,115
	No	43	80,4	12,5	49,0	72,0	84,0	90,0	100,0	
Frequent headaches	Yes	24	82,5	8,0	68,0	76,0	85,5	88,0	93,0	0,475
	No	42	82,1	13,2	49,0	72,0	86,5	92,0	100,0	
Frequent flues	Yes	23	86,1	7,2	68,0	83,0	87,0	90,0	97,0	0,126
	No	43	80,2	12,9	49,0	72,0	83,0	91,0	100,0	
Frequent sore throat	Yes	17	80,4	12,6	55,0	74,0	85,0	88,0	97,0	0,495
	No	49	82,9	11,2	49,0	75,0	87,0	91,0	100,0	
Smelly mouth	Yes	12	83,9	8,4	68,0	78,5	85,5	91,0	93,0	0,855
	No	54	81,9	12,1	49,0	74,0	86,5	91,0	100,0	
Thirst when waking up (dry mouth)	Yes	8	80,6	9,6	68,0	73,0	82,0	85,0	97,0	0,288
	No	58	82,5	11,8	49,0	74,0	87,0	91,0	100,0	
Ear pains	Yes	22	84,4	8,6	68,0	79,0	86,5	91,0	97,0	0,605
	No	44	81,2	12,7	49,0	73,0	85,5	91,0	100,0	
Difficulty in hearing	Yes	4	72,5	5,9	68,0	68,5	70,5	76,5	81,0	0,035
	No	62	82,9	11,5	49,0	75,0	87,0	91,0	100,0	
Difficulty in sleeping	Yes	6	86,2	10,4	72,0	79,0	86,0	97,0	97,0	0,388
	No	60	81,9	11,6	49,0	74,0	86,0	90,5	100,0	
Sleeps little	Yes	7	88,4	9,4	72,0	79,0	91,0	97,0	97,0	0,080
	No	59	81,5	11,6	49,0	74,0	85,0	90,0	100,0	
Snores when sleeping	Yes	22	83,3	9,7	68,0	72,0	87,0	91,0	97,0	0,924
	No	44	81,8	12,4	49,0	74,0	85,5	91,0	100,0	
Drools on the pillow	Yes	20	83,4	9,6	68,0	75,0	87,0	90,0	97,0	0,994
	No	46	81,8	12,3	49,0	74,0	85,5	91,0	100,0	
Breath through the mouth (Day)	Yes	10	83,4	7,8	68,0	81,0	84,0	87,0	97,0	0,747
	No	56	82,1	12,1	49,0	73,0	87,0	91,0	100,0	
Breath through the mouth (Night)	Yes	26	82,8	10,5	60,0	75,0	87,0	89,0	97,0	0,979
	No	40	81,9	12,2	49,0	74,0	85,5	91,0	100,0	
Difficulty chewing	Yes	7	81,3	8,9	68,0	71,0	84,0	88,0	91,0	0,525
	No	59	82,4	11,8	49,0	74,0	86,0	91,0	100,0	
Difficulty swallowing	Yes	2	87,0	0,0	87,0	87,0	87,0	87,0	87,0	0,793
	No	64	82,1	11,7	49,0	74,0	85,5	91,0	100,0	
Been hospitalized	Yes	12	84,3	9,6	68,0	76,5	86,5	91,5	97,0	0,594
	No	54	81,8	11,9	49,0	74,0	86,0	91,0	100,0	
Undergone adenoid surgery	Yes	6	82,7	9,8	69,0	72,0	87,0	88,0	93,0	0,920
	No	60	82,2	11,7	49,0	74,0	85,5	91,0	100,0	
Undergone tonsils surgery	Yes	2	89,5	4,9	86,0	86,0	89,5	93,0	93,0	0,389
	No	64	82,0	11,6	49,0	74,0	85,5	91,0	100,0	
Lack of labial sealing	Yes	11	83,0	8,6	68,0	75,0	87,0	90,0	91,0	0,897
	No	55	82,1	12,1	49,0	74,0	85,0	92,0	100,0	

Legend: SD-standard deviation; Q1 – first quartile, Q3 – third quartile; [1] Mann-Whitney non-parametric test.

Table 4 – Total score of 3rd grade according to the questionnaire answers

		N	Average	SD	Minumum	Q1	Median	Q3	Maximum	p-value[1]
Allergy	Yes	65	76,7	9,5	55,0	69,0	79,0	84,0	92,0	-
	No	-	-	-	-	-	-	-	-	
Allergy to any medicine	Yes	7	80,4	4,5	75,0	78,0	79,0	85,0	88,0	0,385
	No	58	76,2	9,9	55,0	69,0	78,0	84,0	92,0	
Allergy treatment	Yes	14	81,4	8,4	61,0	78,0	82,0	88,0	92,0	0,034
	No	51	75,4	9,5	55,0	68,0	76,0	84,0	92,0	
Rhinitis	Yes	24	77,2	10,3	56,0	70,0	80,0	84,5	92,0	0,577
	No	41	76,4	9,2	55,0	69,0	78,0	84,0	92,0	
Frequent headaches	Yes	21	75,8	8,8	56,0	70,0	79,0	81,0	88,0	0,528
	No	44	77,1	9,9	55,0	69,0	78,5	84,5	92,0	
Frequent flues	Yes	19	77,5	12,1	55,0	70,0	81,0	88,0	92,0	0,386
	No	46	76,4	8,4	57,0	69,0	78,0	82,0	92,0	
Frequent sore throat	Yes	20	72,9	10,3	55,0	64,5	75,0	81,0	88,0	0,048
	No	45	78,4	8,7	56,0	72,0	80,0	85,0	92,0	
Smelly mouth	Yes	16	75,4	8,3	61,0	68,5	75,5	82,0	88,0	0,455
	No	49	77,1	9,9	55,0	70,0	79,0	85,0	92,0	
Thirst when waking up (dry mouth)	Yes	15	77,9	9,5	55,0	72,0	80,0	87,0	90,0	0,513
	No	50	76,3	9,6	56,0	69,0	78,5	84,0	92,0	
Ear pains	Yes	18	75,8	10,0	60,0	68,0	75,0	83,0	92,0	0,602
	No	47	77,0	9,4	55,0	69,0	79,0	84,0	92,0	
Difficulty in hearing	Yes	7	72,9	9,4	61,0	63,0	72,0	81,0	85,0	0,248
	No	58	77,2	9,5	55,0	70,0	79,0	84,0	92,0	
Difficulty in sleeping	Yes	7	78,4	9,4	61,0	72,0	80,0	86,0	88,0	0,567
	No	58	76,5	9,6	55,0	69,0	78,5	84,0	92,0	
Sleeps little	Yes	4	74,3	12,1	61,0	64,5	74,0	84,0	88,0	0,642
	No	61	76,9	9,4	55,0	70,0	79,0	84,0	92,0	
Snores when sleeping	Yes	16	78,5	11,3	55,0	75,0	82,0	86,0	92,0	0,193
	No	49	76,1	8,9	57,0	69,0	76,0	82,0	92,0	
Drools on the pillow	Yes	25	75,5	10,7	56,0	68,0	78,0	83,0	92,0	0,575
	No	40	77,4	8,7	55,0	70,0	79,0	85,0	92,0	
Breath through the mouth (Day)	Yes	8	81,8	3,4	76,0	79,0	83,0	84,5	85,0	0,117
	No	57	76,0	9,9	55,0	69,0	77,0	84,0	92,0	
Breath through the mouth (Night)	Yes	25	77,2	10,9	55,0	70,0	81,0	85,0	91,0	0,422
	No	40	76,4	8,6	57,0	69,0	76,5	82,5	92,0	
Difficulty chewing	Yes	7	80,1	7,7	68,0	72,0	81,0	88,0	88,0	0,304
	No	58	76,3	9,7	55,0	69,0	78,0	84,0	92,0	
Difficulty swallowing	Yes	1	72,0	.	72,0	72,0	72,0	72,0	72,0	0,540
	No	64	76,8	9,6	55,0	69,0	79,0	84,0	92,0	
Been hospitalized	Yes	21	78,2	9,3	56,0	75,0	81,0	85,0	91,0	0,312
	No	44	76,0	9,6	55,0	69,0	76,0	83,5	92,0	
Undergone adenoid surgery	Yes	5	82,4	8,9	68,0	82,0	84,0	86,0	92,0	0,139
	No	60	76,2	9,5	55,0	69,0	78,0	84,0	92,0	
Undergone tonsils surgery	Yes	3	81,3	12,2	68,0	68,0	84,0	92,0	92,0	0,398
	No	62	76,5	9,4	55,0	69,0	78,5	84,0	92,0	
Lack of labial sealing	Yes	24	78,2	9,4	60,0	71,0	79,5	85,0	92,0	0,344
	No	41	75,8	9,6	55,0	69,0	78,0	82,0	92,0	

Legend: SD-standard deviation; Q1 – first quartile, Q3 – third quartile; [1] Mann-Whitney non-parametric test.

Score	4th grade		3rd grade		Total	
	n	%	n		n	%
0	6	9,1	5	7,7	11	8,4
1	8	12,1	5	7,7	13	9,9
2	12	18,2	9	13,8	21	16,0
3	7	10,6	8	12,3	15	11,5
4	6	9,1	10	15,4	16	12,2
5	7	10,6	7	10,8	14	10,7
6	0	0,0	6	9,2	6	4,6
7	4	6,1	5	7,7	9	6,9
8	6	9,1	3	4,6	9	6,9
9	3	4,5	1	1,5	4	3,1
10	3	4,5	0	0,0	3	2,3
11	2	3,0	0	0,0	2	1,5
12	0	0,0	4	6,2	4	3,1
13	1	1,5	1	1,5	2	1,5
14	0	0,0	1	1,5	1	0,8
15	1	1,5	0	0,0	1	0,8
16	8	12,1	5	7,7	13	9,9

Figure 2 – Score in the sample questionnaire

Table 5 – Scores according to the quartile scores of the questionnaire for the 4th grade

	Score	N	Average	SD	Minimum	Q1	Median	Q3	Maximum	p-value[1]
Alphabet	0 to 2	26	25,0	2,0	19,0	24,0	26,0	26,0	26,0	0,249
	3 to 4	13	25,0	1,2	23,0	24,0	25,0	26,0	26,0	
	5 to 7	11	24,7	1,1	23,0	24,0	25,0	26,0	26,0	
	8 or more	16	25,3	1,1	22,0	25,0	26,0	26,0	26,0	
Figure coping	0 to 2	26	8,5	1,7	5,0	7,0	9,0	10,0	10,0	0,419
	3 to 4	13	8,2	1,8	4,0	7,0	9,0	9,0	10,0	
	5 to 7	11	9,2	1,2	7,0	9,0	10,0	10,0	10,0	
	8 or more	16	8,7	1,6	5,0	9,0	9,0	10,0	10,0	
Math	0 to 2	26	11,2	5,4	4,0	6,0	11,5	16,0	20,0	0,055
	3 to 4	13	14,5	2,9	10,0	12,0	14,0	17,0	19,0	
	5 to 7	11	15,0	4,4	6,0	13,0	16,0	18,0	20,0	
	8 or more	16	14,9	4,5	3,0	13,0	16,5	18,0	19,0	
Word dictation	0 to 2	26	21,7	5,1	7,0	21,0	23,0	25,0	29,0	0,405
	3 to 4	13	22,5	5,1	14,0	20,0	24,0	27,0	28,0	
	5 to 7	11	24,4	2,2	20,0	24,0	25,0	26,0	27,0	
	8 or more	16	22,9	2,3	20,0	21,0	22,5	24,5	27,0	
Pseudo words dictation	0 to 2	26	5,1	2,3	0,0	3,0	5,0	6,0	9,0	0,807
	3 to 4	13	5,7	2,2	2,0	4,0	6,0	7,0	9,0	
	5 to 7	11	5,1	1,7	3,0	3,0	6,0	7,0	7,0	
	8 or more	16	5,3	1,4	2,0	5,0	5,5	6,0	7,0	
Total dictation	0 to 2	26	26,8	7,1	7,0	24,0	28,0	32,0	36,0	0,759
	3 to 4	13	28,2	7,0	16,0	25,0	29,0	34,0	36,0	
	5 to 7	11	29,5	3,2	23,0	27,0	30,0	31,0	33,0	
	8 or more	16	28,3	3,4	22,0	26,0	27,5	31,0	34,0	
Memory	0 to 2	26	7,2	2,1	4,0	5,0	7,5	9,0	10,0	0,311
	3 to 4	13	7,6	1,9	4,0	7,0	7,0	9,0	10,0	
	5 to 7	11	8,2	0,6	7,0	8,0	8,0	9,0	9,0	
	8 or more	16	7,3	1,1	6,0	7,0	7,0	8,0	10,0	
Total score	0 to 2	26	78,6	14,3	49,0	72,0	79,5	91,0	100,0	0,420
	3 to 4	13	83,4	9,9	69,0	75,0	87,0	91,0	96,0	
	5 to 7	11	86,5	9,1	68,0	84,0	90,0	93,0	97,0	
	8 or more	16	84,4	7,4	68,0	80,0	86,5	88,0	97,0	

Legend: SD-standard deviation; Q1 – first quartile, Q3 – third quartile; [1] Kruskal Wallis non-parametric test.

Table 6 – Scores according to the quartile scores of the questionnaire for the 3rd grade

	Score	N	Average	SD	Minimum	Q1	Median	Q3	Maximum	p-value[1]
Alphabet	0 to 2	19,0	25,1	1,5	21,0	25,0	26,0	26,0	26,0	0,261
	3 to 4	18,0	23,6	3,4	15,0	23,0	25,0	26,0	26,0	
	5 to 7	18,0	24,8	2,1	18,0	24,0	26,0	26,0	26,0	
	8 or more	10,0	25,0	0,8	24,0	24,0	25,0	26,0	26,0	
Figure coping	0 to 2	19,0	7,6	2,4	0,0	7,0	8,0	9,0	10,0	0,942
	3 to 4	18,0	7,9	1,9	4,0	6,0	9,0	9,0	10,0	
	5 to 7	18,0	8,1	1,8	4,0	7,0	9,0	9,0	10,0	
	8 or more	10,0	8,1	1,4	6,0	7,0	8,5	9,0	10,0	
Math	0 to 2	19,0	10,3	3,6	5,0	7,0	10,0	13,0	17,0	0,742
	3 to 4	18,0	10,4	4,4	3,0	9,0	10,5	13,0	18,0	
	5 to 7	18,0	11,1	4,2	1,0	8,0	12,5	14,0	16,0	
	8 or more	10,0	11,6	4,8	6,0	7,0	11,0	15,0	20,0	
Word dictation	0 to 2	19,0	20,9	3,4	14,0	19,0	21,0	24,0	27,0	0,935
	3 to 4	18,0	21,0	3,8	14,0	18,0	22,0	24,0	26,0	
	5 to 7	18,0	21,4	5,0	11,0	20,0	21,5	25,0	29,0	
	8 or more	10,0	21,0	3,2	17,0	18,0	20,0	24,0	25,0	
Pseudo words dictation	0 to 2	19,0	5,3	1,5	2,0	4,0	5,0	6,0	8,0	0,936
	3 to 4	18,0	5,4	1,3	3,0	5,0	5,0	7,0	8,0	
	5 to 7	18,0	5,2	2,1	2,0	4,0	5,0	7,0	8,0	
	8 or more	10,0	5,6	2,2	2,0	3,0	7,0	7,0	8,0	
Total dictation	0 to 2	19,0	26,3	4,2	19,0	23,0	25,0	29,0	34,0	0,948
	3 to 4	18,0	26,4	4,4	19,0	22,0	27,0	29,0	33,0	
	5 to 7	18,0	26,6	6,4	13,0	23,0	29,0	30,0	37,0	
	8 or more	10,0	26,6	4,7	20,0	23,0	27,0	32,0	32,0	
Memory	0 to 2	19,0	6,7	1,8	3,0	6,0	6,0	8,0	11,0	0,586
	3 to 4	18,0	7,3	1,7	3,0	6,0	7,5	8,0	10,0	
	5 to 7	18,0	7,1	1,3	5,0	6,0	7,0	8,0	9,0	
	8 or more	10,0	7,1	1,9	4,0	6,0	6,5	9,0	10,0	
Total score	0 to 2	19,0	75,9	8,5	65,0	69,0	73,0	84,0	92,0	0,677
	3 to 4	18,0	75,6	9,2	57,0	67,0	76,5	81,0	90,0	
	5 to 7	18,0	77,7	11,5	55,0	70,0	82,0	84,0	92,0	
	8 or more	10,0	78,4	8,9	61,0	72,0	80,5	85,0	88,0	

Legend: SD-standard deviation; Q1 – first quartile, Q3 – third quartile; [1] Kruskal Wallis non-parametric test.

DISCUSSION

Several authors emphasize the high prevalence of respiratory symptoms among children at school age, reaching values higher than 50% [25,26]. Respiratory disorders are common complaints from parents and teachers, who often describe allergy, flues and problems in the posture of the phonological articulators, such as the absence of labial sealing in their children and students. Oral breathing is the most common diagnosis when a series of these difficulties manifest together, which makes it the target of the development of various studies and researches[2-6, 8,9, 17, 22, 25,26].

The learning process occurs gradually and in a complex way, and requiring skills from the phonological, syntactic and semantic components of the language[18]. Cognitive-linguistic skills such as memory, attention and concentration are also essential for the proper development of reading and writing[19]. Few protocols can currently provide the quantitative data regarding the assessment of these skills. Thus, for this research, we used a protocol published and studied in the Brazilian population[24]. Besides, this study went as far as to compare the students from the same public school in city of Belo Horizonte/Minas Gerais.

The average scores obtained in this study by applying the PHCL in areas such as the alphabet, copying figures and mathematics are consistent with those presented by a group of students of the same age and school grade of a school from the city of St. Paulo[27]. As to the areas concerning the word dictation, pseudo words dictation and digit memory in the present study they had lower average values than those reported by children from São Paulo. This difference can be explained by the population, as the survey which was conducted with students from the city of São Paulo excluded all children who presented changes in the otorhinolaryngological

evaluation performed previously, i.e., the authors excluded all children with respiratory disorders. The present work, however, intends to evaluate the impact of the signs and symptoms of mouth breathing on the performance of cognitive-linguistic skills assessed. Knowing that good performance in tasks such as dictation requires good attention, concentration and memory, these data are consistent with several studies that correlate changes of these abilities in children with breathing difficulties[11, 13, 16, 18, 20-22].

Comparing the scores in all areas surveyed in each school grade, there is only a significant difference in the areas of math, word dictation, and total score, and in these skills students in the 4th grade had higher scores than students in the 3rd grade. These data are not in agreement with the previous study[27], which only in the recognition of the alphabet was not observed a statistically significant difference between the averages of the school grades. But once again this difference can be explained by the inclusion and exclusion criteria of the sample, whereas the present study included children with respiratory disorders.

Analyzing the complaints of possible respiratory changes in the surveyed sample it is possible to observe a significant number of children with rhinitis (35.9%), frequent flues (32.1%), earache (30.5%) and drooling (34.4%), and these were the most frequent findings. Although these percentages stand for the involvement of almost a third of the sample, these values are lower than those described in the literature, there are alteration in more than 50% of the studied samples[25,26].

In comparisons of average scores obtained by the school grades in the PHCL with each sign and symptom of oral breathing it was not observed significant differences in any of the studied variables. This alone shows that each complaint of respiratory changes may not mean a problem in the performance of cognitive skills, but all of these changes, which in most cases features a mouth-breathing children, promote the impact which has been described in several conducted studies[5,6, 8,9, 17, 22, 25,26].

In the analysis of the prevalence of signs and symptoms of possible change in breathing mode, i.e., the observation of the impact of several of these complaints in the same child, it was observed that more than 59.1% of the students had scores in QACR between 0 and 4 points . Thus, most children of this research presented up to four signs and symptoms concomitant to oral breathing. In a first assessment it can be considered to be a low commitment, but studies show that allergic conditions alone, not associated with any physical obstruction, can be the etiology of the installation of mouth breathing[2].

Analyzing the quartile QACR score and surveyed areas, the comparison was made between the scores obtained in QARC and PHCL. The data show that children who had a greater number of concurrent respiratory characteristics, did not necessarily have lower scores on measures of each researched area. This data underscores the importance of evaluating exactly those characteristics which are present respiratory, as it can be seen children who express only one or two of these characteristics, which are sufficient to promote significant changes in the regular development[2].

It is evident the great difficulty in confronting major changes, a major social impact, like respiratory and language, as many variables necessarily need to be controlled, such as teaching methodology which children are exposed, the region where they live, environmental factors, among others. In addition, confirmation of the diagnosis of disorders such as mouth breathing is hampered by the need for a series of multidisciplinary assessments and examinations, even though this is highly common among children of school age children.

This information reinforces the importance of this study in which even if it was not found significant correlations between the performance of students in the cognitive-linguistic skills and the presence of signs/symptoms of an altered respiratory, important data of both variables were presented. Thus, it emphasizes the need for further research aimed at confronting learning difficulties and respiratory problems in studies with larger samples, aiming the control of the largest number of variables involved.

CONCLUSION

There was no significant relationship between the performance of cognitive-linguistic skills and the presence of respiratory characteristics in students from a public school in Belo Horizonte, the children who presented signs and symptoms of respiratory abnormalities did not present performance below those without these changes in skills evaluated.

We emphasize the importance of further studies that seek to investigate the relationship between school performance and respiratory problems.

RESUMO

Objetivo: relacionar características respiratórias com o desempenho em habilidades cognitivo-linguísticas de crianças de uma escola pública da grande Belo Horizonte. **Método:** estudo transversal, observacional e descritivo. Das 180 crianças recrutadas 131 atenderam aos critérios de inclusão e exclusão. Foram avaliadas 66 crianças da 4ª série e 65 da 3ª série do ensino fundamental, de ambos os gêneros, com idades entre nove e dez anos. Foi utilizado um questionário para investigação das características respiratórias e um protocolo previamente publicado e adaptado a população brasileira para avaliação das habilidades cognitivo-linguísticas. As informações coletadas foram analisadas por meio dos testes de Mann-Whitney e Kruskal Wallis, ao nível de significância de 1%. **Resultados:** não foi observado valor de p<0,01 na comparação entre as características respiratórias e as pontuações obtidas por cada série no teste das habilidades cognitivo-linguísticas. Observou-se que 59,1% dos alunos apresentaram escores no questionário de pesquisa das características respiratórias entre zero e quatro pontos, indicando pouco comprometimento respiratório. **Conclusão:** não foi encontrada relação significante entre o desempenho de habilidades cognitivo-linguísticas e a presença de características respiratórias em escolares de uma escola pública de Belo Horizonte, sendo que as crianças que apresentaram sinais e sintomas de alterações respiratórias não obtiveram desempenho abaixo daquelas sem estas alterações nas habilidades avaliadas.

DESCRITORES: Aprendizagem; Escolaridade; Transtorno de Aprendizagem; Respiração Bucal

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