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Oral language skills in Brazilian children with obstructive sleep apnea

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A R T I C L E I N F O

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A B S T R A C T

Background: Obstructive sleep apnea (OSA) is associated with a negative impact on neurocognitive development in children. Receptive/expressive oral language is a complex process, with limited investigations on the repercussion of OSA. This study aimed to analyze receptive and expressive oral language skills in children with obstructive sleep apnea (OSA).
Methodology: This study included 52 children (27 females, 51.92 %) with a mean age of 7 ± 2 years (age range of 4–11 years), which underwent type 3 polysomnography (PSG). The participants were divided into N-OSA (n = 16) and OSA (n = 36) groups based on the apnea-hypopnea index. The speech-language therapist evaluated hearing and oral language for phonology, expressive semantics, syntax, receptive semantics (Peabody Image Vocabulary Test), pragmatics, and understanding of verbal instructions (Token Test).
Results: Oral language assessments showed a difference in the pragmatics subsystem ($p = 0.047$), with positive correlation between OSA severity and oral language functions such as pragmatics and syntax (desaturation index, $p = 0.045$).
Conclusion: Obstructive sleep apnea (OSA) had a negative impact on oral language skills, including the syntax and pragmatics subsystems.

1. What this paper adds

This paper adds the complete language protocol to evaluate children with obstructive sleep apnea, and the results about the correlation between in the pragmatics subsystem of language with OSA severity, and pragmatics and syntax with desaturation index.

2. Introduction

Sleep-related obstructive breathing disorders are highly prevalent in the pediatric population. According to estimates, primary snoring affects from 4 % to 34 % of this population, whereas obstructive sleep apnea (OSA) affects from 1 % to 5 % (Marcus et al., 2012) of them. Preschool children seem to be more affected due to the frequent hypertrophy of the palatine and pharyngeal tonsils in

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this age group (Choi et al., 2010). The causal relationship with obesity increases at school age, increasing the prevalence of these disorders (Lennon et al., 2017).

Diagnostic assessment should include the clinical history and an examination investigating the signs and symptoms commonly related to OSA, as well as the nutritional status of the child (Lennon et al., 2017). Researchers have recently reported the importance of the evaluation and rehabilitation of muscle and orofacial functions, recommending orofacial myofunctional therapy to prevent recurrence of obstructive breathing disorders (Correa et al., 2020; Guilleminault et al., 2013).

The gold standard diagnosis of sleep-disordered breathing is full-night polysomnography (PSG), considering the apnea-hypopnea index (AHI) for the diagnosis and classification of OSA severity (Marcus et al., 2012). However, approximately only 4 % of children are properly diagnosed (Meltzer et al., 2010), with a subsequent delay in treatment (Marcus et al., 2012). Alternative and more feasible diagnostic tools, such as unsupervised polygraphy or nocturnal oximetry, have thus been proposed for the optimization of queues (Alonso-Alvarez et al., 2015; Savini et al., 2019).

Language development is an important phase of child development, especially when it can be threatened by risk factors (e.g., sleep disorders, in the case of OSA). Oral language typically involves receptive and expressive skills. Receptive language encompasses receiving and decoding or interpreting language, whereas expressive language is the encoding or production of a message in a gestural or oral form. Language can thus be subdivided into the domains of form (syntax, phonology), content (semantics), and use (pragmatics) (Correa et al., 2017). Assessment considering all these domains is of paramount importance in identifying the child's ongoing change for early adoption of rehabilitation strategies.

Existing literature mentions the negative impact of obstructive sleep apnea (OSA) on neurocognitive development (Marcus et al., 2012; Soylu et al., 2016), with only few studies focusing on language functions. Some authors assessed overall development in children with adenotonsillar hypertrophy by using the Denver II Developmental Screening Test. In their study, the group with obstructive breathing disorders performed significantly worse in language skills (Soylu et al., 2016). Correa et al. (2017) addressed OSA-18 and its correlations with phonological working memory, breathing function, and aspects of orofacial muscle, comparing children with and without language disorders (de Castro Correa et al., 2017). Lundeborg et al. (2009) reported a prevalence of 67 % of phonological disorders in children before adenotonsillectomy (Lundeborg et al., 2009). Andreou and Tasioudi (2015) showed a lower performance of morphosyntactic production in OSA children aged 4.1–6.11 years old in relation to normal developing children (Andreou & Tasioudi, 2015).

These literature data show a possible correlation between changes in receptive/expressive language and primary snoring/OSA. Notwithstanding, studies addressing all language subsystems, excluding influencing factors such as cognitive and auditory ones, are still scarce (Correa et al., 2017). Therefore, the present study hypothesized an association between OSA and oral language delay in children, considering expressive and receptive oral language skills. Investigations in this regard can estimate the impact of sleep obstructive breathing disorders on oral language development, as well as contribute to the identification of these alterations, aiming at early intervention.

The present study analyzed receptive and expressive oral language skills in children with OSA.

3. Methods

The research was approved by the Research Ethics Committee of the institution (protocol number CAAE 47871115.2.0000.5411). All parents signed a written consent form, and children signed an age-specific assent form.

The present study included children between 4 and 11 years of age, of either sex. All children were accompanied at the pediatric ENT ambulatory of a tertiary university hospital due to mouth breathing and/or snoring. Total sample size was 52 children, considering a 5 % prevalence of neurocognitive disorders in OSA children, an error of 5 %, and a 95 % confidence interval. Inclusion and exclusion criteria were as follows:

- Inclusion criteria: Children of either sex, aged between 4 and 11 years, with no hearing impairment (type A bilateral tympanometric curve), who provided consent to participate in the research as well as the consent of their parents, and who completed all the proposed assessments.
- Exclusion criteria: Children with neurological disorder, genetic syndrome, neuromuscular disorder, using drugs that depress the respiratory system, with any hearing impairment (immittance audiometry), or with intellectual deficit (Raven's Colored Progressive Matrices Test (Ikeda, Horta, B. W., & Dolci, 2012), excluding participants with scores corresponding to mental disability).

All parents answered the Brazilian Economic Classification Criterion questionnaire (Andrade & Alves, 2019), which stratifies the population in 5 major groups (A, B, C, D, E). For analysis simplification, subgroups were not considered.

All children/parents answered the OSA-18 questionnaire (Fernandes & Teles Rda, 2013) validated for Brazilian Portuguese. This tool, with scores between 18 and 126, assesses the impact of sleep disorders on children's quality of life, considering low (score < 60), moderate (score between 60 and 80), and high values (score > 80).

The children underwent complete otorhinolaryngological evaluation and hearing screening by immittance audiometry (immittance audiometer model ZS76 -IB, Madsen). Anthropometric measures of weight and height were categorized by z-score.

Participants were invited to perform a full-night unsupervised type 3 PSG (Philips Respironics Stardust II) prior to surgery. In this procedure, a sleep specialist blinded to the study scored the participants in accordance with the recommendations of the American Academy of Sleep Medicine (Kirk et al., 2017). Considering the recommendations for unsupervised exams, obstructive sleep apnea (OSA) was diagnosed when AHI was equal to or higher than 5.6 events per hour (Alonso-Alvarez et al., 2015).

Based on the PSG results, the sample was divided into two groups: no OSA (N-OSA, AHI < 5.6 events/h) and OSA (AHI ≥ 5.6 events/h). It is noteworthy that this division is still an initial proposal (7), but this parameter was adopted considering the type of polysomnography performed in this study.

The speech therapist evaluated each child individually for his/her receptive and expressive oral language, considering the phonology, syntax, semantics, and pragmatics subsystems. All tests were video-recorded for later analysis.

***Phonology (expressive language)*:** For this assessment, the therapist used the protocol of the ABFW Child Language Test (Pupo et al., 2016), standardized for evaluation in Brazilian Portuguese in the pediatric population. The child should name (34 words) and imitate (39 words), allowing the analysis of phonological processes. Any phonological process at an unexpected age, as well as idiosyncrasies, were considered as alterations. All words named correctly were summed for the percentage of correct speech (Sell & Sweeney, 2020).

***Syntax (expressive language)*:** In this step, the therapist used a syntactic consciousness test to assess metalinguistic ability via four subtests: grammatical judgment, grammatical correction of ungrammatical sentences, grammatical correction of ungrammatical and asymmetric phrases, and word categorization (Capovilla et al., 2004). The test consists of 40 sentences and 15 words, with a maximum score of 55 points, and normality parameters adjusted for age.

***Semantics (expressive language)*:** The therapist analyzed semantics using the ABFW Child Language Test (Carbonieri & Lucio, 2020). This test investigates the competence of picture naming/semantics in nine conceptual categories - clothing, animals, food, means of transport, furniture and utensils, professions, places, shapes and colors, toys and musical instruments (totaling 107 images). The test indicates whether the child made the designation by the usual word, if there was no designation, or if the child replaced the usual word with another one. Children who presented changes in one or more conceptual vocabulary fields (considering their age group) were classified with a delay in semantics. Additionally, words were counted according to the results of usual word designation, no designation, or substitution processes.

***Semantics (receptive language)*:** In this step, the therapist applied the Peabody Image Vocabulary Test to assess vocabulary

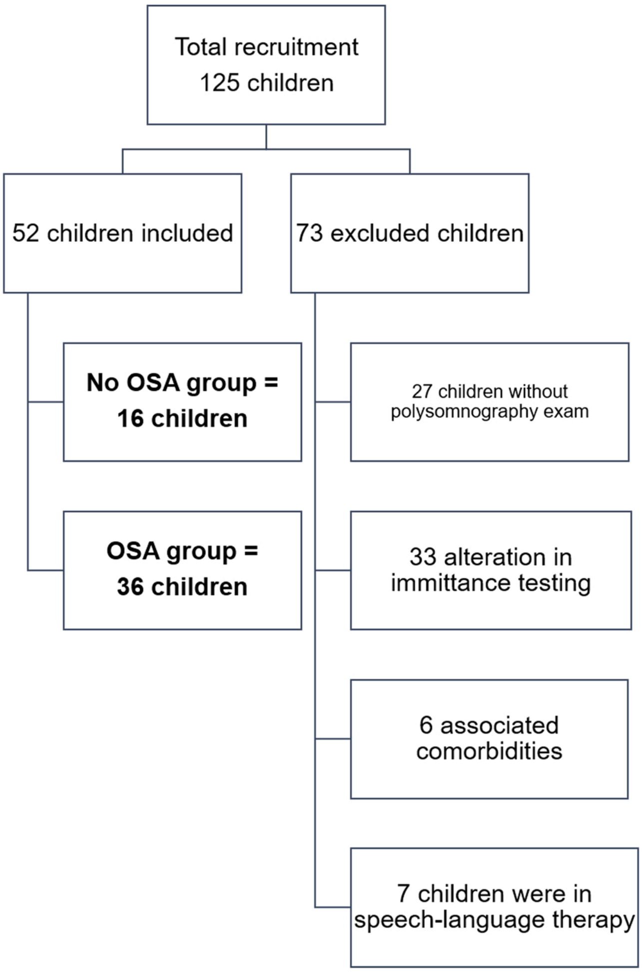

Fig. 1. Flowchart of sample selection for this research. Observation - Out of the 27 children without type 3 polysomnography (PSG), 23 did not perform the exam before surgery, and 4 were excluded due to exam failure (loss of any sensor).

comprehension skills. This test uses five training boards, followed by 125 test boards organized in increasing order of difficulty, each consisting of four drawings. The maximum score was 125 points, with normality parameters adjusted for age (Carbonieri & Lucio, 2020).

***Pragmatics (expressive language)*:** The pragmatic sample for the assessment of narrative uses the book "Frog, where are you?", composed by a sequence of 29 images without any written text. The child is given the task to elaborate the story after having seen the whole book. The story of each child was video-recorded and transcribed in full for analyzing the following aspects (Ganthous et al., 2017):

- Construction (in six levels): descriptive sequence (1), action sequence (2), sequence of related events (3), incomplete episode (4), complete episode (5), and multiple episodes (6).
- Complexity level of the narrative: the child was given 1 point for each element in the scenario: theme, plot, challenges, resolution, and conventional markers, with a maximum of 31 points.
- Coherence: classified into four levels (I, II, III, and IV) considering character, theme, event, and outcome.

***Comprehension of verbal instructions*:** The Token Test assesses receptive language, detecting mild disorders of language comprehension (Willinger et al., 2017). The test uses two shapes (small and large) of circles and squares in five colors: black, green, red, yellow, and white, arranged in a specific order. The child has to select the correct figure for each of the 36 commands (for example: black, small circle), scoring 1 (one) point for a correct answer at the first attempt and 0.5 point for a correct answer at the second attempt.

3.1. Data analysis

Data of descriptive statistics are presented as frequency and percentages for qualitative variables, and as mean, median, standard deviation, and minimum and maximum values for quantitative variables. For the inductive analysis, the SAS software (version 9.4 for Windows) was used, with $p < 0.05$ set as the level of significance. Student t test was used to compare means for continuous variables between groups. Variables with p-values < 0.1 in the univariate analysis ($\alpha = 10$ %) were included in a linear regression model, and estimates adjusted to a multivariate model were calculated, with respective confidence intervals of 95 %. Pearson correlation was used to compare between the AHI and the categorized variables.

4. Results

The final sample consisted of 52 children (27 female children, 51.92 %) with a mean age 7 ± 2 years. The children were separated into two groups based on the PSG criteria for OSA diagnosis, with 36 children being allocated to the OSA group. The groups were similar for age and sex ($p = 0.84$ and $p = 0.85$, respectively), as well as for BMI z-score ($p = 0.44$). Body mass index (BMI) z-score distribution was analyzed by observing the similarity between the two groups ($p = 0.44$). Fig. 1 shows the inclusion and exclusion process.

The total score of sleep quality based on OSA-18 differed between participants ($p = 0.02$), as well as domains 1 ($p = 0.012$) and 3 ($p = 0.023$). The table below shows the values of the apnea-hypopnea index (AHI), desaturation index, and minimum saturation for each group (Table 1).

Table 1
Distribution of BMI, OSA-18 questionnaire, and polysomnographic parameters in N-OSA and OSA groups.

		N-OSA	OSA	p
BMI	Eutrophy	8 (50 %)	10 (27.78 %)	0.270
	Underweight	0	2 (5.56 %)	
	Overweight	6 (37.50 %)	13 (36.11 %)	
	Obesity	2 (12.50 %)	11 (30.56 %)	
OSA-18 questionnaire	Sleep disturbance	12.62 ± 6.61	18.03 ± 7.01	0.012 *
	Physical suffering	16 ± 5.37	17.44 ± 5.86	0.404
	Emotional suffering	7,56 ± 6.44	11.31 ± 4.71	0.023 *
	Daytime problems	8,25 ± 4.99	9.58 ± 3.82	0.296
	Parents' concern	12 ± 7.27	15.61 ± 7.55	0.114
OSA-18 questionnaire total		56.44 ± 26.62	71.97 ± 19.3	0.021 *
Impact on quality of life (OSA-18 questionnaire)	0 low	11 children (68.75 %)	9 children (25 %)	0.53
	1 moderate	3 children (18.75 %)	13 children (36.11 %)	
	2 high	2 children (12.50 %)	14 children (38.89 %)	
Polysomnography	AHI	3.62 ± 1.16	11.37 ± 5.42	< 0.001 *
	Oxygen Desaturation index	4.53 ± 4.15	22.51 ± 21.84	0.005 *
	Mean oxygen saturation	96.63 ± 1.09	94.07 ± 3.44	0.012 *
	Minimum oxygen saturation (Nadir)	83.25 ± 9.71	75.61 ± 12.39	0.039 *

Caption: N-OSA group: AHI < 5.6 events/h, OSA group: AHI ≥ 5.6 events/h. BMI: body mass index; AHI: apnea-hypopnea index; Student's t-test was used to compare domains, the OSA-18 questionnaire score, and polysomnographic data between groups; Kruskal-Wallis analysis of variance (ANOVA) was used to compare the frequency of BMI and ratings of the impact on quality of life by OSA-18; (*) statistical significance was set at $p < 0.05$.

Intellectual assessment (Raven's Test) revealed average age-related performance in 22 (42.31 %) and higher age-related performance in 30 (57.69 %) children, with no difference between the N-OSA and OSA groups ($p = 0.34$).

Oral language assessments lasted from 1 h and 20 min to 1 h and 40 min for each child. Table 2 shows the results of oral language assessments. The evaluation of the pragmatics subsystem showed differences between groups.

When considering the socioeconomic level, the comparisons were close to the significance threshold ($p = 0.056$). When considering the classes, Socioeconomic level C predominated in the sample (N-OSA group: 31.25 %; OSA group: 44.44 %), with a similar distribution between groups ($p = 0.70$). Likewise, there was no statistically significant difference between BMI for the OSA and N-OSA groups ($p = 0.14$).

When comparing the pragmatic subsystem between groups, adjusted for socioeconomic level in a multivariate regression model, statistical significance was maintained for the language domain ($p = 0.023$) (Table 3).

The correlation between oral language assessments and polysomnographic parameters differed for all language subsystems (Table 4).

Regarding language subsystems (phonology, receptive semantics, expressive semantics, and syntax), 24 children showed a delay in one subsystem, 14 children in two, 9 children in three, 2 children showed changes in four tests, and only 3 children showed no changes.

5. Discussion

This pioneer study in the assessment of oral language in OSA children found positive correlations between several subareas of linguistics and respiratory events and oxygen desaturation. Children with obstructive sleep apnea performed worse in phonology, syntax, and expressive and receptive semantics, and significantly worse in pragmatics, as already reported in a previous study (Correa et al., 2017). Regarding the understanding of instructions and receptive vocabulary, the two groups under study performed similarly, diverging from literature findings that show worse results for understanding in OSA children (Correa et al., 2017). This divergence can be due to the fact that the present study was controlled for other bias variables, such as auditory alterations and cognitive performance. As the performance of oral language might be influenced by different socioeconomic levels (Panes et al., 2018), this variable was tested. Language assessment results did not differ significantly as a function of socioeconomic status in our study group. These results enhance our hypothesis that OSA might be a risk factor for poor development and performance of language skills, possibly mediated by hypoxemia and sleep fragmentation (Rosenzweig et al., 2015).

Our study group showed no difference for obesity (BMI z-score) between N-OSA and OSA children, contrary to previous literature that shows obesity as a risk factor for OSA (Lennon et al., 2017). However, the difference in tonsil size between both groups under study indicates this factor as the most important regarding OSA severity, as already reported in previous studies (Choi et al., 2010; Marcus et al., 2012; Savini et al., 2019; Soylu et al., 2016).

Type 3 PSG confirmed OSA diagnosis, with children allocated to the OSA group scoring much worse in the OSA-18 questionnaire. Regarding the impact of sleep on quality of life, OSA children showed a moderate rating, suffering more frequently a higher impact. Other studies also showed correlation between the OSA-18 questionnaire and PSG results (Kang et al., 2016; Zhao et al., 2018), even with a reduced version of the questionnaire (Soh et al., 2018). However, there is still no consensus in the literature (Burghard et al., 2019).

The correlation between language skills and specific polysomnographic parameters showed divergent results. Syntax and pragmatics correlated negatively with OSA severity according to the AHI classification and the desaturation index. In other words, the higher the desaturation index or the AHI, the lower the performance of these subsystems, strengthening the hypothesis of this study.

However, for phonology and vocabulary, these correlations were inverse (as expected), with a higher desaturation index indicating better performance.

The nadir value did not correlate with any subsystem, although the OSA group showed a significantly lower nadir. This shows that hypoxemia might not be the only factor influencing neurocognitive and language skills in OSA.

The small differences in AHI possibly do not express a difference in language data as in other sleep-specific and systemic findings,

Table 2
Results of the oral language assessments of groups (divided by the apnea-hypopnea index), presented as mean and standard deviation.

ORAL LANGUAGE ASSESSMENT	N-OSA	OSA	p
Syntax	33.8 ± 17.0	33.0 ± 15.0	0.88
Phonology	97.49 ± 5.26	95.07 ± 7.95	0.20
Expressive semantics ND	2.38 ± 0.75	2.86 ± 1.24	0.71
Expressive semantics SP	20.94 ± 9.86	23.11 ± 11.07	0.50
Receptive semantics (Peabody)	106 ± 17.62	102 ± 17.66	0.48
Token Test	25.3 ± 8.23	26.8 ± 5.89	0.24
Pragmatic Construction level	2.25 ± 1.39	2.31 ± 1.55	0.33
Pragmatic Complexity level	0.44 ± 0.44	0.82 ± 0.69	0.047 *
Pragmatic Coherence level	1.81 ± 0.40	1.86 ± 0.64	0.60

Caption: N-OSA group: AHI < 5.6 events/h, OSA group: AHI ≥ 5.6 events/h, ND: no designation, SP: substitution processes. Student's t-test was performed; (*) statistical significance was set at $p < 0.05$.

Table 3
Comparison between OSA and N-OSA groups for the pragmatic language subsystem, adjusted for socioeconomic level.

Domain	Predictor variable	β	Standard error	p-value
Pragmatic	*Intercept*	-0.112	0.427	0.794
	Complexity level	0.453	0.193	0.023 *
	Socioeconomic level	0.024	0.017	0.174

Legend: *p-value obtained by the multivariate linear regression model (5 % significance level)

Table 4
Correlation between oral language assessments and polysomnographic parameters.

ORAL LANGUAGE ASSESSMENT	Mean±SD	AHI	Oxygen Desaturation index	Mean oxygen saturation	Minimum oxygen saturation (Nadir)
Syntax	33.2 ± 15.5	r = 0.767 p = 0.007 *	r = −0.279 p = 0.045 *	r = 0.387 p = 0.005 *	r = 0.212 p = 0.131
Phonology	94.9 ± 8.68	r = 0.225 p = 0.108	r = 0.438 p = 0.001 *	r = −0.453 p = <0.001 *	r = −0.151 p = 0.287
Expressive semantics ND	3.07 ± 4.47	r = 0.122 p = 0.418	r = 0.246 p = 0.099	r = −0.362 p = 0.013 *	r = −0.227 p = 0.129
Expressive semantics SP	22.4 ± 10.7	r = 0.103 p = 0.466	r = 0.352 p = 0.010 *	r = −0.426 p = 0.002 *	r = −0.120 p = 0.395
Receptive semantics (Peabody)	103 ± 17.6	r = −0.070 p = 0.622	r = −0.001 p = 0.993	r = 0.020 p = 0.888	r = −0.056 p = 0.695
Token Test	26.3 ± 6.65	r = 0.082 p = 0.562	r = −0.139 p = 0.327	r = 0.251 p = 0.073	r = 0.033 p = 0.815
Pragmatic Construction level	2.29 ± 1.49	r = 0.144 p = 0.307	r = −0.229 p = 0.103	r = 0.346 p = 0.012 *	r = 0.090 p = 0.526
Pragmatic Complexity level	0.702 ± 0.644	r = 0.046 p = 0.744	r = −0.307 p = 0.027 *	r = 0.336 p = 0.015 *	r = 0.248 p = 0.077
Pragmatic Coherence level	1.88 ± 0.732	r = 0.360 p = 0.009 *	r = 0.087 p = 0.541	r = 0.096 p = 0.497	r = −0.122 p = 0.388

Caption: SD: standard deviation; AHI: apnea-hypopnea index; ND: no designation, SP: substitution processes. Pearson correlation was performed; (*) statistical significance was set at $p < 0.05$.

such as urinary neurotransmitters (Shi et al., 2019), which may enable new neurocognitive correlations. It is necessary to consider that neurocognitive skills are influenced in a multifactorial way, generating greater variability of findings (Choi et al., 2010; Lennon et al., 2017; Marcus et al., 2012). In this sense, longitudinal findings must also be considered due to the possibility of later implications (Marcus et al., 2012).

Different skills seem to be heterogeneously affected by desaturation oxygen levels, sleep fragmentation, and possibly REM. This evidences the need to better understand the repercussion of OSA on neurocognitive development, including linguistic skills. The present study performed type 3 polysomnography, with no EEG-EOG monitoring; thus, sleep fragmentation and distribution of REM and NREM sleep phases was not possible. Andreou and Tasioudi (2015) reported specific linguistic changes in OSA children; however, they did not correlate their findings to PSG parameters (Andreou & Tasioudi, 2015).

In an overview, language disorders had high occurrence in at least one communicative level (94.23 %) in both groups. This might be due to a delay in the update of the applied tests, limited by the validation of the instruments into Brazilian Portuguese. Additionally, we raise the possibility of this younger generation being influenced by excessive use of technologies. Exploration with an emphasis on the manipulation of cell phones (fine motor coordination) instead of games such as hopscotch (gross motor coordination) may affect oral language development. This hypothesis is illustrated in a study that investigated cognitive, motor, and language development in children between 12 and 35 months with and without exposure to television for more than 2 h daily. The authors of that study concluded that the exposed group performed worse for language acquisition and development (Lin et al., 2015).

It should also be considered that changes in language development are strongly influenced by extrinsic factors like parental attitude. Such a factor can shape and attenuate possible negative effects due, for example, to socioeconomic circumstances. This illustrates how powerful the influence of parents is on language development (Jung et al., 2018).

Adenotonsillectomy treatment alone does not reestablish neurocognitive functions that may be impaired in these children. This was already demonstrated in a study that used the Developmental Neuropsychological Assessment (NEPSY test) to evaluate visual/auditory attention and order comprehension. In that randomized trial, children who underwent adenotonsillectomy and those on the waiting list showed similar results after one year of intervention (Marcus et al., 2013).

The strength of this study was the demonstration that children with respiratory complaints should be evaluated and accompanied by an interdisciplinary team since their first diagnosis of sleep breathing disorders. This may enable detecting communication disorders, allowing early planning of a complete treatment to enhance not only respiratory and neurocognitive functions, but also communication skills.

A limitation of this study is the lack of a control group evaluated longitudinally. This was due to the intense flow of assistance from the public hospital, which is responsible for attending children from adjacent cities, thus having a lack of spaces for multiple assistance, without specific complaints. Furthermore, it was difficult to directly match the parameters of the language tests with the literature, as these tests are dependent on language similarity.

The protocol proposed in this study investigates the diverse levels of receptive and expressive oral language. It can be used for future research expanding the scope of other psycholinguistic skills, considering the linguistic variability of each language.

6. Conclusion

OSA children had worse development of language skills parameters, including syntax and pragmatics. The study showed a correlation between OSA severity and polysomnographic parameters such as oximetry and desaturation index. This field of neurocognitive development is a new frontier, and more research is needed to better understand oral language skills and sleep parameters.

CRediT authorship contribution statement

Camila de Castro Corrêa: Conceptualization, Methodology, Formal analysis, Writing – original draft, Review, Investigation, **Luciana Paula Maximino**: Conceptualization, Methodology, Formal analysis, Writing – original draft, Review, Supervision, **Dagma Venturini Marques Abramides**: Methodology, Formal analysis, Writing – original draft, Review, Resources, **Silke Anna Theresa Weber**: Conceptualization, Methodology, Formal analysis, Writing – original draft, Review, Resources, Supervision.

Conflict of interest

None.

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