

Obstructive sleep apnea syndrome and morphosyntactic development in children

Georgia Andreou, Matina Tasioudi
Department of Special Education, University of Thessaly, Greece
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Abstract

Obstructive sleep apnea syndrome (OSAS) is a common sleep disorder that ranges up to 3% in childhood epidemiological studies. Language acquisition seems to be affected by OSAS' occurrence but until now research has examined the general language ability without focusing on specific language areas. Therefore, we focused on the morphosyntactic ability of 25 children with OSAS (aged 4.1-6.11) and 25 typically developing children (TDC) of the same age. Performance in morphosyntax was tested by using two subtests (morphosyntactic comprehension and morphosyntactic production) of a standardized language test. Results showed that children with OSAS had significantly lower performance in morphosyntactic production compared to TDC. However, we found no statistically significant difference in morphosyntactic comprehension between the two groups.

Key words: OSAS, children, morphosyntactic development

Introduction

Obstructive Sleep Apnea Syndrome (OSAS) is a common sleep-related breathing disorder in which the upper airway becomes blocked repeatedly during sleep, resulting in increased respiratory effort and snoring, recurrent hypoxemia, and frequent arousals from sleep. Moreover, the prevalence of OSAS in children ranges up to 3% in different epidemiological studies and the incidence peak was found in pre-school children (Gozal 2008). Among the major contributing factors to childhood OSAS, adenotonsillar hypertrophy emerges as the most important condition, while obesity seems to be another basic cause (Alonso-Álvarez et al. 2014). During the first decade of life human brain and neurological functions develop rapidly acquiring the basic cognitive and mental abilities. The sleep disturbances mentioned above lead to increased risk for learning, neurocognitive and behavioral disorders, poor academic performance and school failure (Andreou & Agapitou 2007, among others). Preliminary data suggest that some of these cognitive deficits may be reversible following treatment of sleep apnea in children (Montgomery-Downs et al. 2005); however, factors such as age at treatment time, duration of sleep disordered breathing, pre-morbid intellectual level, socioeconomic status, or the effectiveness of treatment may adversely affect long-term outcome.

The cause of cognitive deficits in OSAS patients seems to be complicated. Some researchers have found a significant correlation between cognitive

impairment and daytime sleepiness related to sleep defragmentation, while others attribute cognitive decline to nocturnal hypoxemia. Moreover, it is suggested that the frontal lobes of the brain and the prefrontal cortex are affected by sleep defragmentation and hypoxemia. Another model proposed is the microvascular theory suggesting that a vascular compromise might exist in the small vessels of the brain. The most recent theory suggests that sleep defragmentation and hypoxemia effects are synergistic and they interact with vulnerable brain regions such as hippocampus, prefrontal cortex, subcortical gray and white matter (for a more detailed review see Andreou et al. 2014).

In conclusion, several studies have found that language acquisition is affected by the occurrence of OSAS, but until now research has mostly examined the general language ability without focusing on specific language areas. Therefore, our goal is to investigate a language area that is quite challenging for Greek children with developmental language disorders, namely morphosyntax (Stavrakaki 2005).

Experimental Methodology

In the present study, the participants were 25 children with OSAS, according to polysomnography examination performed at the University Hospital of Larissa, Greece, (Apnea/Hypopnea Index/hour (AHI) = 5.25, SD = 3.26) aged 4.1 to 6.11 years old (Mean Chronological Age (MCA) = 5.6, SD = 1.02) and 25 typically developing children (TDC) of the same chronological age (MCA = 5.7, SD = 1.16/ AHI = 0). Performance in morphosyntax was tested using 2 subtests of the standardized psychometric language test L-a-T-o I, created for the Greek language (Tzouriadou et al. 2008). The first subtest examined the morphosyntactic comprehension and consisted of 13 experimental sentences. Three pictures of the same main concept were presented for every experimental sentence and the participant had to choose the one that matched best the sentence heard.

e.g. Pola skilia kathontai kato
 Many dogs are sitting down

The second subtest examined the morphosyntactic production and consisted of 13 experimental sentences which were presented orally along with pictures that illustrated the content of each sentence. The examiner pronounced each sentence and stopped at the point where the child needed to add the word or words missing. The missing words were nouns and verbs in singular or plural form, nouns in genitive case, verbs in different tenses (past, present and future) or passive forms.

e.g. Afto to fortigo kouvalai pola koutia. Afto kouvalai... (ena kouti)
 This truck carries a lot of boxes. This one carries...(one box)

We performed independent sample t-tests to compare the performance of the two groups of participants on the tests administered.

Results

According to our results, as presented in Table 1, there was a statistically significant difference in the scores for morphosyntactic production between the two groups. No statistically significant difference was found for morphosyntactic comprehension.

Table 1. Mean scores of OSAS and TDC groups in the morphosyntactic tests

Group of participants	Morphosyntactic Comprehension				Morphosyntactic Production			
	<i>M</i>	<i>SD</i>	<i>P</i>	<i>t</i>	<i>M</i>	<i>SD</i>	<i>p</i>	<i>t</i>
OSAS	4.12	1.77	0.024	-2.36	9.88	2.60	0.001	-3.61
TDC	6.45	1.86			11.36	1.21		

Discussion

As seen above children with OSAS had significantly lower performance in morphosyntactic production compared to the TDC group. On the other hand, although the OSAS children's performance was lower than that of the TDC in morphosyntactic comprehension, we found no statistically significant differences between the two groups. Our results are consistent with the literature findings indicating that morphosyntactic production is more challenging than morphosyntactic comprehension in language disorders (Laws & Bishop 2003). Moreover, we found, as expected, that OSAS affects language acquisition in early childhood (Gozal et al. 2008), and we managed to extend the findings of the literature by focusing on a language area that seems to be problematic in children with OSAS, as it has also been found in other developmental language disorders for the greek language (Stavarakaki 2005). We suggest that our findings could result from sleep defragmentation and hypoxemia which affect the function of hippocampus, prefrontal cortex, frontal lobes, and subcortical white matter, since these brain regions are highly associated with language functions and memory (Nagy et al. 2004, Vigneau et al. 2006, among others). Therefore we emphasize that as long as childhood OSAS is concerned medical treatment should be combined with early language intervention in order to avoid the risk of poor language development and the consequent school failure.

References

- Alonso-Álvarez M.L., Cordero-Guevara J.A., Terán-Santos J., Gonzalez-Martinez M., Jurado-Luque M.J., Corral-Peñañiel J., Duran-Cantolla J., Kheirandish-Gozal L. and Gozal D. 2014. Obstructive sleep apnea in obese community-dwelling children: the NANOS study. *Sleep* 37(5), 943-949.
- Andreou. G. and Agapitou, P. 2007. Reduced language abilities in adolescents who snore. *Archives of Clinical Neuropsychology* 22 (2), 225-9.

- Andreou G., Vlachos F. and Mankanikas K. 2014. Effects of Chronic Obstructive Pulmonary Disease and Obstructive Sleep Apnea on Cognitive Functions: Evidence for a Common Nature. *Sleep Disorders*, 1-18.
- Gozal D. 2008. Obstructive Sleep Apnea in Children: Implications for the Developing Central Nervous System. *Semin. Pediatr. Neurol.* 15(2), 100-106.
- Laws G. and Bishop D. V. M. 2003. A comparison of language in adolescents with Down syndrome and children with specific language impairment. *Journal of Speech, Language and Hearing Research* 46, 1324–1339.
- Montgomery-Downs H., Crabtree V.M., Gozal D. 2005. Cognition, sleep and respiration in at-risk children treated for obstructive sleep apnea. *European Respiratory Journal* 25(2), 336-342.
- Nagy Z., Westerberg H. and Klingberg T. 2004. Maturation of white matter is associated with the development of cognitive functions during childhood. *Journal of Cognitive Neuroscience* 16(7), 1227-1233.
- Stavrakaki, S. 2005. Greek neurolinguistics: The State-of-The-Art. *Journal of Greek Linguistics* 5, 181-228.
- Tzouriadou, M., Singolitou, E., Anagnostopoulou, E. and Vakola, I. 2008. Psychometric criterion of Language Adequacy (L-a-T-o). Thessaloniki, Aristotle University of Thessaloniki and Ministry of Education.
- Vigneau M., Beaucousin V., Hévry P.Y., Duffau H., Crivello F., Houde O., Mazoyer B. and Tzourio-Mazoyer N. 2006. Meta-analyzing left hemisphere language areas: Phonology, semantics, and sentence processing. *Neuroimage* 30(4), 1414-1432.