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EDITORIAL (INVITED)

Sleep disordered breathing in preschool children; still smart but for how long?

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A relationship between sleep disordered breathing (SDB) and cognitive function in children has long been postulated. Indeed, in school-age children, there is substantive evidence that both obstructive sleep apnoea syndrome (OSAS) and primary snoring (PS) are associated with cognitive and behavioural deficits [1]. For practical reasons, much of this research has focused on school-aged children with a relative paucity of studies addressing the relationship between SDB and cognitive function in preschoolers when snoring and SDB are at peak prevalence [2]. In one of a limited number of studies to include prospectively recruited polysomnography (PSG) defined controls, Jackman et al. found that SDB of any severity was associated with poorer behaviour but not cognitive performance [3]. The other studies focusing on outcomes in preschool children diagnosed with SDB on PSG have been limited by a lack of comprehensive cognitive and behavioural assessments [4, 5] or have not included a representative sample [6].

In the current study, Pietropaoli and colleagues seek to add to the preschool literature by testing cognitive function in a group of children, aged 2 to 6 years, who were referred to their

tertiary sleep centre and underwent PSG for assessment of SDB [7]. The control group in this study was recruited from a local kindergarten and was 'screened' by virtue of history and examination. The control group did not undergo PSG but did undergo the same neurocognitive assessment as the study group. The test used in the current study was the WPSSI-111 (a reliable and valid measure for overall cognitive ability in this age group). In total, there were 77 children with SDB (41 with PS/mild OSAS and 36 with mild/moderate OSAS) and 83 controls. Of relevance, there were no differences in the two SDB groups regarding duration or age of onset of SDB. The primary finding of the study was that there were no differences between groups on any measure of cognitive function. As the authors acknowledge, one of the main limitations of this study is that the control group was recruited based on a validated questionnaire [8] but without PSG. Nevertheless, this study adds to the evidence that preschool children with SDB do not have cognitive deficits compared to controls as measured by currently available tests.

So what does this all mean? The study by Jackman and colleagues did not find cognitive deficits but did find differences in behaviour especially between the PS/mild OSAS group and controls. The reasons for these findings are not immediately apparent and seem at odds with the current literature describing cognitive as well as behavioural deficits in older school-age children. It is potentially also at odds with the prevailing theory that these deficits are mediated by intermittent hypoxia and sleep fragmentation when surely these insults should have a more profound affect on the rapidly developing preschool brain? [9] If we are to assume that our currently available neurocognitive tests are sensitive enough to detect problems in preschool children, one logical explanation for the difference in findings is that the duration of exposure to SDB is important. Is it that the cognitive deficits apparent in older children are due to the cumulative effects on the

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developing brain of years of SDB? The aforementioned study by Jackman et al. raises two questions. Firstly, whether it is more relevant to assess behaviour than cognitive function in younger children, and secondly, whether these deficits in behaviour impact on longer-term cognitive outcomes; for example, does impaired attentiveness interrupt foundational learning? Prospective longitudinal studies are required to answer these questions.

It is further confounding, when considering the causal mechanism of SDB-associated morbidities, that current evidence suggests that cognitive and behavioural changes are independent of the severity of SDB. Indeed, there is mounting evidence that children with PS, often considered to be benign, have significant daytime morbidity [10]. Additionally, we know that not all children with SDB develop cognitive and behavioural deficits. As discussed by the current authors, the most widely accepted mechanistic explanation for the SDB-associated neurobehavioral morbidity in children is the effect of intermittent hypoxia and sleep fragmentation on the development of the prefrontal cortex (PFC) [9]. The PFC is implicated in executive functioning and is the last part of the brain to fully develop. Cellular injury in this area is proposed to explain the psychological phenotype associated with OSAS. However, the hypothesis that this is a proportional or dose-dependent relationship does not well explain the deficits seen in children with PS.

The challenge for the clinician is how to incorporate this evidence into practice when counselling the parent of a pre-school child diagnosed with OSA. Although there is an absence of long-term longitudinal data, the question arises whether there may be a window of opportunity during which the deficits may be prevented if SDB is identified and treated early enough and perhaps conversely that treatment instigated beyond this point may be ineffective in improving cognitive outcomes. It is pertinent to consider in this context that the only RCT of adenotonsillectomy for the treatment of SDB in children (the CHAT study) showed benefit in behaviour, quality of life and PSG parameters but not in the primary outcome which was executive function [11]. This study also highlights that the natural history of SDB in a significant proportion of children is to resolve without treatment and without demonstrable cognitive decline.

It should be acknowledged that SDB in children has physiological consequences beyond behaviour and cognitive function including the effects on systemic inflammation [12] and on the cardiovascular system [13]. For the clinician, the accurate identification of which children with SDB are most likely to benefit from treatment is of paramount importance. Future research should be longitudinal and aim to better define this group. In young children, how do we predict in whom SDB will resolve versus who will develop deficits? In early childhood, is behaviour a proxy for cognitive function later in childhood? The story so far is far from clear, and the findings of the current study are not altogether reassuring.

Conflict of interest   The authors declare that they have no competing interests.

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