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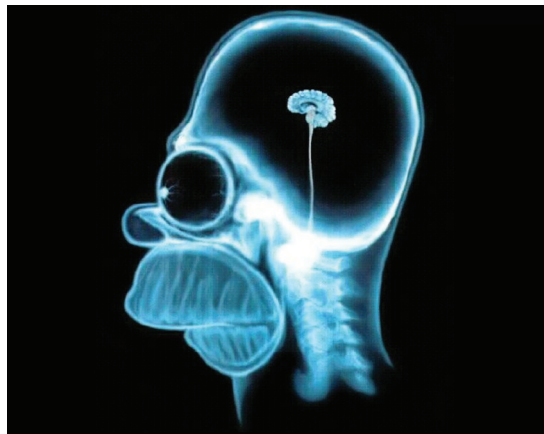


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## OSA and Cognitive Impairment

It is well known that Obstructive Sleep Apnea (OSA) is a common cause of excessive daytime sleepiness. How common is demonstrable impairment of cognition in patients with OSA? A study looking at this revealed that one in four newly diagnosed OSA patients had a severe and distinctive neuropsychological dysfunction mainly involving inductive and deductive thinking as well as constructive ability.<sup>1</sup> Frontal dysfunction and decrement in psychomotor efficiency and vigilance appeared to be the most consistent explanation for characterizing the profile of neuropsychological test results among these OSA patients.<sup>2</sup> In addition to vigilance decrements, impaired information processing and decreased short-term memory span have been observed. The cognitive performance of OSA patients seems very similar to the cognitive decline found after sleep loss.<sup>3</sup>

Are decrements of cognitive ability only temporary similar to the effects of sleep deprivation or are the effects of OSA on the brain more permanent? Some studies suggest that the changes in cognition are similar to those seen in sleep deprivation. One such study examined the cerebral response to a verbal learning task in OSA patients using functional magnetic resonance imaging. OSA patients showed increased brain activation in bilateral inferior frontal and middle frontal gyri, the cingulate gyrus, areas at the junction of the inferior parietal and superior temporal lobes, thalamus, and cerebellum. Better free recall performance in the OSA group was related to increased cerebral responses within the left inferior frontal gyrus and left supramarginal area. Recruitment of additional brain regions to participate in verbal learning performance in OSA patients likely represents an adaptive compensatory recruitment response, similar to that observed in adults following total sleep deprivation.<sup>4</sup> However, other studies have shown that permanent changes in the brains of OSA patients may occur. A voxel based MRI morphology analysis revealed a significantly lower gray matter concentration within the left hippocampus, a key area for cognitive processing ( $p=0.004$ ) in apneic patients than in those without sleep disordered breathing.<sup>5</sup> The oxygen sensitive hippocampus is important in the formation of episodic and declarative memory but procedural



memory required in learning new motor skills is more dependent on the cerebellum. Interestingly, in one study OSA patients did not show procedural skill learning deficits. These same patients, however, did show deficits in other neuropsychological tests.<sup>6</sup>

What about cognitive impairment in the more formative years? Childhood OSA is associated with deficits of IQ and executive function and also with possible neuronal injury in the hippocampus and frontal cortex. Researchers

have speculated that untreated childhood OSA could permanently alter a developing child's cognitive potential.<sup>7</sup> At what age does this become an issue? A study of five year old children with sleep disordered breathing demonstrated symptoms are associated with poorer executive function and memory skills and lower general intelligence.<sup>8</sup>

Does CPAP therapy improve cognition in patients with OSA? A battery of neuropsychological tests were administered to 23 adult patients with severe OSA (age: 56.5+/-6.13; AHI: 54.9+/-13.37) and to 23 age- and education-matched controls. The OSA patients were evaluated in a baseline condition and in two follow-up treatment sessions (after 15 days and 4 months of CPAP, respectively). At baseline, OSA patients had a significant impairment, compared to controls, in tests of sustained attention, visuospatial learning, executive function, motor performance, and constructional abilities. The longitudinal evaluation showed that after a 15-days CPAP treatment attentive, visuospatial learning and motor performances returned to normal levels. A 4-months CPAP treatment did not result in any further improvement in cognitive tests. Performance on tests evaluating executive functions and constructional abilities was not affected by short- and long-term treatment with CPAP. The findings of this study confirm the hypothesis of partial reversibility of cognitive dysfunction in OSA patients after CPAP.<sup>9</sup>

<sup>1</sup> J Sleep Res. 2004 Mar;13(1):79-86.

<sup>2</sup> Sleep. 2002 Jun 15;25(4):401-11.

<sup>3</sup> Sleep. 2004 Jun 15;27(4):685-93.

<sup>4</sup> Neuroimage. 2006 Jul 15;31(4):1817-25. Epub 2006 Apr 19.

<sup>5</sup> Sleep Med. 2003 Sep;4(5):451-4.

<sup>6</sup> Sleep. 2002 Jun 15;25(4):401-11.

<sup>7</sup> PLoS Med. 2006 Aug;3(8):e301.

<sup>8</sup> J Pediatr. 2004 Oct;145(4):430-2.

<sup>9</sup> Brain Res Bull. 2003 Jun 30;61(1):87-92.