

## Cognitive status in Down syndrome individuals with sleep disordered breathing deficits (SDB)

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### Abstract

Twelve subjects with Down syndrome underwent polysomnographic studies during night sleep and performed the Mini-Mental state test and the Raven Progressive Matrices (RPM), sets A, B, and B<sub>1</sub>. Sleep-disordered breathing (SDB) deficits were observed in Down syndrome individuals and their Mini-Mental and RPM scores were extremely low. Regression analysis of the results revealed that the number of apneas per hour was related with the results of the RPM, set A, which were also related with the orientation of Mini-Mental test, indicating that the more apneas an individual has the more difficulties he has in the kind of visuo-perceptual skills, including orientation, associated with normal right hemisphere functioning, which are tested by set A of the RPM. © 2002 Elsevier Science (USA). All rights reserved.

*Keywords:* Down syndrome; SDB; Mini-Mental; Raven

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### 1. Introduction

Down syndrome has often been associated with cognitive deficits as well as breathing difficulties during sleep.

Subjects with Down syndrome tend to obtain low scores at tests measuring visual-perceptual abilities (Saviolo-Negrin, Soresi, Baccichetti, Pozzan, & Trevisan, 1990), visuospatial organization and short-term memory (Devenny et al., 1996; Vicari, Carlesimo, & Caltagirone, 1995), planning and attention (Das, Divis, Alexander, Parrila, & Naglieri, 1995), and verbal performance and language, in general (Berry, Groeneweg, Gibson, & Brown, 1984; Chapman, Schwartz, & Bird, 1991; Greenspan & Delaney, 1983; Loveland & Kelley, 1988; Vicari et al., 1995).

Cognitive deficits on the part of subjects with Down syndrome are closely related with sleep-disordered breathing (SDB) deficits, as previous studies have reported

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(Engleman, Kingshott, Martin, & Douglas, 2000; Naegele, Thouvard, & Pepin, 1995; Scheltens et al., 1991). SDB deficits include more than ten apneas in one hour of sleep, hypoventilation and arterial oxygen desaturation and have often been described in subjects with Down syndrome (Clark, Schmidt, & Schuller, 1980; Kasian, Duncan, Tyrrell, & Oman-Ganes, 1987; Loughlin, Wynne, & Victoria, 1981; Marcus, Keens, Bautista, Pechman, & Davidson, 1991). These subjects have many predisposing factors for SDB deficits such as midfacial and mandibular hypoplasia, glosptosis, an abnormally small upper airway with superficially positioned tonsils and relative tonsillar and adenoidal encroachment, increased secretions, an increased incidence of lower respiratory tract anomalies, obesity and generalized hypotonia with resultant collapse of the airway during inspiration (Fink, Madaus, & Walker, 1975; Southall et al., 1987; Strome, 1986).

In view of the above findings, we performed polysomnographic studies in individuals with Down syndrome and tested their visuoperceptual skills and their mental state in search of any kind of relation between the results of the polysomnographic study, and their performance in the trials testing their visuoperceptual skills and mental state. Therefore, the aim of our study was to document the prevalence of SDB and cognitive deficits in adults with Down syndrome.

## 2. Materials and methods

Twelve individuals, 6 males and 6 females, with Down syndrome were recruited from a day care Down Syndrome Institute. Their mean age was  $21.66 \pm 4.11$ . Informed consent was obtained from the parents or the guardians of each subject. This was the reason for which the particular 12 individuals were chosen, since the polysomnograms were performed during night sleep at home and the cooperation of the parents or the guardians of the individuals with Down syndrome was necessary for the normal performance of polysomnograms. None of the individuals had congenital heart disease or asthma and none of them had undergone tonsillectomy or adenoidectomy before the experiment.

Overnight polysomnographic studies were performed for all individuals at their home for 5 h. For this purpose, we used a portable breathing heart function JAGER machine, which was put on half an hour before the individual's night sleep by their parents or guardians. All of them slept spontaneously without sedation.

The following parameters were measured: airflow by thermistor, snoring by microphone on neck, arterial oxygen saturation ( $\text{SaO}_2$ ) by pulse oxymetry, and heart rate by electrocardiogram. Polysomnograms were defined as abnormal if they demonstrated one or more of the following: more than ten episodes of apneas per hour of sleep,  $\text{SaO}_2 < 95\%$  per event, and heart rate  $> 60$  pulses per minute. The recordings were scored through automated programs. The results of all sleep studies were evaluated by the Physiology Laboratory at the Medical School of the University of Thessaly.

In addition, the individuals were visited at the Down Syndrome Institute during daytime within a week's time since the performance of the polysomnogram where we filled in the Epworth Sleepiness Scale (ESS) for them and performed the Raven Progressive Matrices (RPM), sets A, B, and B<sub>1</sub> (Raven, Court, & Raven, 1976) and the Mini-Mental State test (Folstein, Folstein, & McHugh, 1975), in two separate sessions, in two separate days one after the other. All three sets of the RPM consist of 12 items of incomplete figures. The missing part is depicted in one of the six response alternatives given below the figure and all the items call for pattern matching. The first (A) set tests the kind of visuoperceptual skills associated with normal right hemisphere functioning (Denes, Semenza, & Stoppa, 1978). In the other sets of RPM items, the task shifts from one of pattern completion to reasoning by analogy at

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