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## Sensory perception of patients with sleep disorders

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### Abstract:

**Background and Aim:** It is well known that patients with sleep debt may have sensory deficit and complain of sensory troubles, however, little literature has been devoted to sensory perception of patients with sleep disorders. The aim of this paper is to explore sensory perception profile of sleep disorder patients.

**Methods:** Sleep of patients and controls was systematically recorded during a one-night polysomnography. Sleep disorders diagnosis were based on the ICSD2d classification. 41 patients aged from 21 to 75 years-old and 20 controls aged from 21 to 40 years-old have been interviewed and the “Visual/audio/kinesthesia” 25 items scale applied, this scale can quantify the proportion of vision, audition or kinesthesia is used for learning by each individual, based on the number of points given to each perception type.

**Results:** The groups were divided into 4: Sleep apnea, Insomnia, Hypersomnia and Controls, all of them had a visual preference. Sleep patients (16 with sleep apnea, 15 with insomnia, 6 with hypersomnia and 3 with narcolepsy) were compared with controls and their perceptual profile wasn't statically different; the average visual score was of 10.2 vs 9.6 ( $p=0,38$ ); audio score of 7.6 vs 7.8 ( $p=0,78$ ) and kinesthesia score of 7.2 vs 7.6 ( $p=0,56$ ). When making comparisons in between each category of the sleep disorder including controls there were also no significate difference in the visual score ( $p=0,9$ ); audio score ( $p=0,6$ ) and kinesthesia score ( $p=0,76$ )

**Conclusion:** Our study showed no difference in the perception profile of patients with sleep disturbances compared with controls. However, the scale used consisted of a subjective evaluation made by the patient and the number of patients included were too small; So, more studies need to be performed to better explore their perception, which may help clinicians in taking better care of their patients with sleep disabilities and poor quality of life.

**Keywords:** Sleep disorders, sleep debt, perceptual learning.

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### INTRODUCTION

Sensory perception is the result of the information obtained from the “outside” world processed by the sensory systems, such as visual, auditory, language (read/write) and kinesthetic (1). Different groups may use the senses in a particular combination in order to obtain and learn new tasks and information (2). So, each individual can be classified according to his most effective type of perception in order to process and understand the world. Sleep disturbances have shown to impair the attention and memory processes and consequently, provoke changes in the sensory perception pattern (3).

After sleep deprivation, individuals showed better

performance in auditive than visual tasks, which suggest that sleep disturbances can prioritize one type of perception over another (4). Based on that, our study purpose is to explore sensory perception profile of sleep disorders patients coming to a sleep disorder center, so we can evaluate if any correlation should exist between the sleep disturbances cited above and the perception profile of the patients.

### METHODS

Sleep of patients and controls was systematically recorded during a one-night polysomnography. Sleep disorders diagnosis was based on the ICSD2d

classification. A "Visual/audio/kinesthetic" scale was applied to 43 patients (18 women and 25 men) aged 20 to 75 years old and 18 controls (8 women and 10 men) aged from 21 to 40 years old. The scale contained 25 multiple-choice questions that were answered with only one right choice (5, 6). This scale consisted of a subjective quick evaluation, which can graduate the influence of each sense in the learning process and show an individual perceptual outline, which was considered as our primary outcome. However, as it consists of a brief and indirect questionnaire, it may not be efficient to show slight differences in between perceptual combinations and had no the power to evaluate the perceptual practical application.

Were included in the study, all the patients from 20 until 75 years old that already have done a polysomnography and had a defined diagnosis. Afterwards, they went in a period of two weeks to the Sleep Center located at the Hospital Hotel Dieu – Paris, France. All the controls had a normal sleep structure and quality; they had sleep disorders excluded by a normal polysomnography exam and a medical consultation with a sleep specialist.

The patients were divided into three groups based on their sleep diagnosis: sleep apnea, insomnia and hypersomnia. Sleep apnea group included patients with sleep apnea and another concomitant sleep disturbance and patients presenting sleep apnea isolated of another sleep disturbance. Hypersomnia group included patients with idiopathic hypersomnia together with narcoleptic ones. Moreover, insomnia group included individuals with diagnosis of insomnia. Three patients with restless legs syndrome diagnosis were excluded.

Based on the number of choices related to each perception style, the subjects were classified in visual, audition, kinesthetic or dual (more than one predominant perception style). The results were analyzed using parametric and non-parametric tests according to the normality of the data using the software prism 5 to compare the sleep disturbance groups and the controls.

## RESULTS

In all groups (sleep apnea, insomnia, hypersomnia and controls), the visual perception was the predominant style. The average visual score of the groups with sleep disturbances compared with the control group was of 10.2 vs 9.6 ( $p=0,38$ ); audio score of 7.6 vs 7.8 ( $p=0,78$ ) and kinesthesia score of 7.2 vs 7.6 ( $p=0,56$ ). Therefore, the first analysis showed there was no difference between the sleep disturbance groups as a whole compared with the control group regarding the score of each group in the different sensory perceptions.

When looking to the four groups separately, the  $p$  values were also not significant; the visual perception presented  $p=0,9$ , auditory  $p=0,6$  and kinesthetic  $p=0,76$ . Therefore, there was no statistical significance between the groups of sleep disorders regarding the score of each perception kind.

The comparison was made also with the chi-square and Fisher exact test, taking into consideration the total number of subjects classified into each category. In the control group, there were 60% ( $n=9$ ) visual, 20% ( $n=3$ ) auditory, 13% ( $n=2$ ) kinesthetic and 7% ( $n=1$ ) dual. In the sleep disturbance group, there were 51% ( $n=22$ ) visual, 16.3% ( $n=7$ ) auditory, 16.3% ( $n=7$ ) kinesthetic and 16,3% ( $n=7$ ) dual subjects. The comparison of these groups showed a  $p=0,92$ . In the diseases separately, the distribution was 62.5% ( $n=10$ ) visual, 12.5% ( $n=2$ ) auditory, 12.5% ( $n=2$ ) kinesthetic and 12.5% (2) dual for sleep apnea; 47% ( $n=7$ ) visual, 20% ( $n=3$ ) auditory, 27% ( $n=4$ ) kinesthetic and 6% ( $n=1$ ) dual for insomnia and 37.5% ( $n=3$ ) visual, 12.5% ( $n=1$ ) auditory, 12.5% ( $n=1$ ) kinesthetic and 37.5% ( $n=3$ ) dual for hypersomnia. Although the distribution between the groups was different, with a greater representation of the dual group in hypersomnia patients, and the kinesthetic group in insomnia patients, there was no statistically significant difference comparing these groups with the others.

## DISCUSSION

Our results did not showed significant results. Although, the insomnia group showed the greatest changes in the perception profiles distribution. This could suggest that insomnia generated a stimulus for perception changes visual and kinesthetic perceptions are the more accessible sensory options to sleep disordered situations. It is already known that the inhibition of one of the perception senses, such as using a sensory substitution device, which use sound or touch to convey information that is normally perceived by vision, can induce the development of another sense after short training; and enable the subject to perform the same tasks using a different perception skill (7). Therefore, it confirms the possibility of perception priority mutation, and is a possible explanation for the sensory changes by stimulus that are inherent of the sleep diseases, like sleep deprivation and sleep fragmentation.

As it was not used a functional test to evaluate the perception utilization, this shift may not be clarified. The test used was simple and self-applied, which gave to it a big adhesion but a low power to evaluate the real proportion of perceptual use. There are evidences that sleep deprivation (SD) is responsible for impairing different types of attention and for reducing the visual

processing capacity (3). Moreover, tasks of sustained visual attention are also sensitive to sleepiness (4), and REM sleep deprivation impairs visual perceptual learning tasks (3). Other than the visual perception, verbal learning is another critical cognitive function susceptible to sleep deprivation (8). Some studies showed that behavioral compensation after sleep deprivation was not efficient, and some of the changes in cerebral activation that followed sleepiness may contribute to poorer recall performance after verbal stimulus. In particular, the reduced response of the left temporal lobe to verbal learning (auditory perception) following SD might have been associated with this deficit (8).

The finding of a common pattern of change in behavioral responsiveness to auditory and visual stimuli during sleep deprivation suggests that sleep deprivation may impair attentional control networks that are common to both sensory modalities. However, it is worth noting that auditory psychomotor vigilance tasks (PVT) performed after sleep deprivation had faster and less variable responses than the responses to visual PVT (4). This difference between auditory and visual responses may be due to differences in the perception, the speed of processing and/or the sensitivity of auditory and visual systems to sleepiness (4).

A perceptual deficit comes with a cognitive process impairment that is also noted after sleep fragmentation. Young healthy volunteers can compensate for these stimuli in an acute way. However, it was suggested that older subjects and subjects with chronic sleep disorders, such as insomnia or Obstructive Sleep Apnea (OSA), as the subjects in our group, may be unable to compensate for this level of imposed disturbance (sleep fragmentation) and may thus respond differently in neurophysiological and neurocognitive terms (9). This situation highlights the possible influence of these stimuli in the perceptual shift.

Therefore, a study using a bigger population and more broad neurophysiological methods may be capable to show perceptual shifts in between these patients.

## CONCLUSION

All the impairments that the imposed disturbance to sleep can bring to the attention and perception processing, depends on sleep modifications such as deprivation and fragmentation that can occur in insomnia, hypersomnia and sleep apnea cases. Despite the presence of this stimulus, our study could not show a significant shift in the perceptual profile.

The population studied was narrow and this should be the main explanation of non-significant results. Therefore, more studies need to be performed to better

explore the sleep disorder patient's perception, which may help clinicians in taking better care of their patients with sleep disabilities and poor quality of life.

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## Conflict of interest and financial disclosure

The authors followed the International Committee or Journal of Medical Journals Editors (ICMJE) form for disclosure of potential conflicts of interest. All listed authors concur with the submission of the manuscript, the final version has been approved by all authors. The authors have no financial or personal conflicts of interest.

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