

# Oximetry Analysis in Prediction of Abnormal AHI and MWT

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## Oxygen saturation

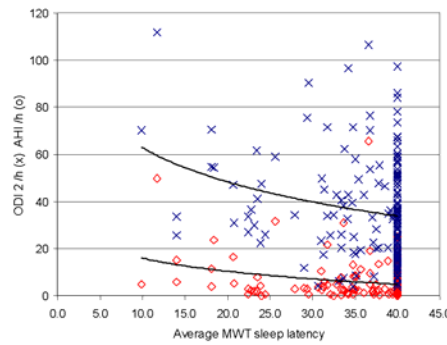
Apnea-hypopnea index (AHI) is the main objective criteria in the diagnosis of obstructive sleep apnea syndrome. Because arterial oxygen saturation (SaO<sub>2</sub>) correlates with the apnea-hypopnea index, oximetry has been used in screening applications [1]. In the present study we wanted to compare different SaO<sub>2</sub> analysis methods in the prediction of abnormal AHI and in the prediction of the impaired ability to maintain wakefulness (MWT).

## AHI, MWT

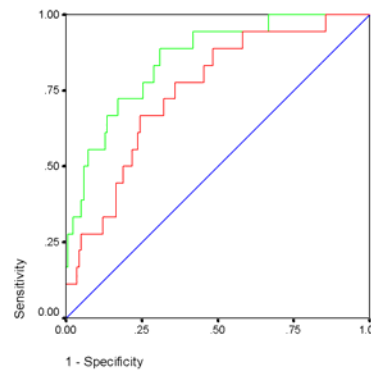
We studied 183 train drivers and controllers in a sleep laboratory. Full night polysomnography was followed by the Maintenance of Wakefulness Test (MWT) on the following day. Respiratory disturbances were monitored with thermistor and static-charge-sensitive bed (SCSB). Apnea-Hypopnea index above 15/h was chosen for an abnormal cut-off level and the mean sleep latency below 19.4 min (of the four consecutive 40 min MWT tests) was similarly considered abnormal.

## Maximum, mean, minimum, SD,....

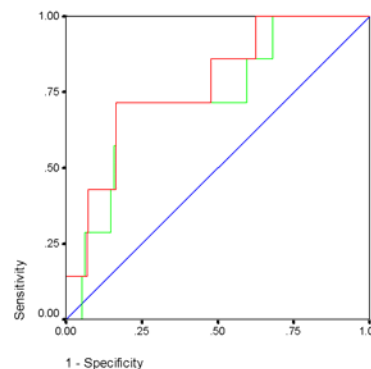
Beside the maximum, mean, minimum and the standard deviation of the nocturnal SaO<sub>2</sub>, oxygen desaturation indexes (ODI) were calculated at 2-6/h cut points. Also, the cumulative time spend below saturation values of 90-98% (TIM 90-98) were assessed and a modified, deep ODI 4-95 (desaturation of at least 4% reaching at least 95%), the variability (VA) of the SaO<sub>2</sub> curve and a weighted cumulative time spend below certain saturation values (SIT) were calculated [2, 3, 4]. The used analysis methods were evaluated by the receiver operating characteristics (ROC) area-under-the-curve (AUC) statistics for the defined abnormal AHI and MWT levels.



**Figure 1. Relationship between average MWT sleep latency (min) and AHI/h and ODI 2/h.**



**Figure 2. ROC curves for detecting abnormal AHI (>15/h) using ODI 2/h (red) and ODI 6/h (green).**



**Figure 3. ROC curves for detecting abnormal MWT (<19.4 min) using ODI 2/h (red) and ODI 6/h (green).**

## AHI > 15/h, MWT <19.4 min

18 out of the 183 analyzed subjects had AHI over 15/h and 7 had MWT less than 19.4 min. For the abnormal AHI, the largest AUC values were obtained with ODI 6 (0.85), followed by ODI 5 (0.84), ODI 4 (0.83), ODI 4-95 (0.83), ODI 3 (0.80), TIM 92 (0.80), TIM 90 (0.77), TIM 94 (0.77) and SIT 94 (0.77). For the abnormal MWT, the largest AUC values were obtained with AHI (0.83), ODI 2 (0.78), ODI 3 (0.76), ODI4-95 (0.74), ODI 4 (0.74), ODI 5 (0.74) and ODI 6 (0.73). Neither the variability (VA) or the weighted cumulative time (SIT) predicted the abnormal AHI and MWT values significantly.

## ODI 6 for AHI, ODI 2 for MWT

The results show that different parameters of the used oximetry recordings predict respiratory disturbances and sleepiness. For the estimation of an abnormal apnea-hypopnea index (AHI>15/h), tighter criterias like ODI 6/h would provide the highest prediction. For the estimation of abnormal sleepiness (MWT<19.4 min), the use of AHI proved to be the most predictive, followed by ODI 2, ODI 3 and ODI 4-95. Overall predictive value of SaO<sub>2</sub> was higher for AHI than for MWT abnormality.

## References

- [1] Netzer N, Eliasson AH, et al. Overnight Pulse Oximetry for Sleep-Disordered Breathing in Adults. *Chest* 2001; 120:625-33.
- [2] Chesson AL, Anderson MW, et al. Comparison of two methods of quantitative assessment of hypoxemia in patient with sleep disorders. *Sleep Medicine* 2001;37-45.
- [3] Epstein LJ, Dorlac GR. Cost-effectiveness Analysis of Nocturnal Oximetry as a Method of Screening for Sleep Apnea-Hypopnea Syndrome. *Chest* 1998; 113: 97-103.
- [4] Levy P, Pepin JL, et al. Accuracy of Oximetry for Detection of Respiratory Disturbances in Sleep Apnea Syndrome. *Chest* 1996; 109:395-399.

**Table 1. Oximetry parameters in AHI <15/h, >15/h and MWT >19.4 min, <19.4 min groups.**

	n	AHI	Mean	SD	Min	Deep	ODI2	ODI4	ODI6	VA	TIM96	TIM94	TIM92	TIM90	SIT96	SIT94
<b>AHI&lt;15/h</b>	<b>165</b>	<b>3.7</b>	<b>95.1</b>	<b>1.9</b>	<b>56.3</b>	<b>6.2</b>	<b>34.3</b>	<b>6.2</b>	<b>1.9</b>	<b>1.6</b>	<b>4.7</b>	<b>1.0</b>	<b>0.3</b>	<b>0.2</b>	<b>9.9</b>	<b>3.2</b>
SD		3.5	1.0	0.9	7.6	5.9	19.9	5.9	2.0	0.6	2.4	1.3	0.7	0.4	8.2	5.3
<b>AHI&gt;15/h</b>	<b>18</b>	<b>25.9</b>	<b>94.0</b>	<b>2.7</b>	<b>57.1</b>	<b>19.2</b>	<b>54.8</b>	<b>19.2</b>	<b>8.8</b>	<b>2.3</b>	<b>6.1</b>	<b>2.5</b>	<b>1.0</b>	<b>0.6</b>	<b>19.5</b>	<b>9.5</b>
SD		13.2	2.1	1.5	9.6	18.0	25.5	18.0	13.7	1.3	2.3	2.2	1.5	1.1	18.3	15.1
<b>MWT&gt;19.4 min</b>	<b>176</b>	<b>5.4</b>	<b>95.0</b>	<b>2.0</b>	<b>56.3</b>	<b>7.2</b>	<b>35.4</b>	<b>7.2</b>	<b>2.5</b>	<b>1.6</b>	<b>4.8</b>	<b>1.1</b>	<b>0.4</b>	<b>0.2</b>	<b>10.6</b>	<b>3.6</b>
SD		7.8	1.2	1.0	7.8	8.6	20.6	8.6	5.1	0.7	2.4	1.4	0.7	0.5	9.8	7.0
<b>MWT&lt;19.4 min</b>	<b>7</b>	<b>16.5</b>	<b>94.3</b>	<b>2.3</b>	<b>58.0</b>	<b>14.0</b>	<b>60.2</b>	<b>14.0</b>	<b>4.1</b>	<b>2.5</b>	<b>5.7</b>	<b>2.5</b>	<b>1.2</b>	<b>0.5</b>	<b>17.5</b>	<b>8.0</b>
SD		16.2	1.6	1.2	8.1	10.5	28.4	10.5	3.0	1.4	2.7	2.7	1.8	0.8	13.7	9.3