Title: Assessment of a Support Vector Machine Classifier for the Detection of Sleep Apnea at-Home in COPD Patients

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RATIONALE. Obstructive sleep apnea (OSA) is a common comorbidity in chronic obstructive pulmonary disease (COPD) patients. It is known that coexistence of both conditions leads to higher cardiovascular morbidity and mortality. Therefore, screening for OSA in COPD patients showing symptoms of sleep-disordered breathing is strongly encouraged. In this regard, portable monitors could be very useful in order to improve early diagnosis. Nevertheless, portable monitoring is still not recommended for OSA detection in patients with pulmonary comorbidities such as COPD. Hence, further research is needed to assess properly unsupervised monitoring as screening tool for OSA in COPD patients. The aim of this study is to assess the influence of suffering from COPD in the diagnostic performance of an automated classifier for OSA based on clinical data and unsupervised oximetry at home.
METHODS. A population of 193 patients referred to the sleep unit due to moderate-to-high clinical suspicion of OSA and regardless of COPD composed our training dataset, which was used to design a computer-aided diagnostic algorithm based on a support vector machine (SVM). SVMs are binary classifiers that search for the optimum decision boundary between the classes under study, i.e. OSA negative *versus* OSA positive. Clinical (age, gender, body mass index, hypertension) and oximetric variables were used. Two validation sets were analyzed to assess the generalization ability: (i) 110 patients without COPD from the sleep unit and (ii) 68 patients with COPD from the Pneumology outpatient facilities, all showing moderate-to-high clinical suspicion of OSA. All subjects underwent in-hospital polysomnography (PSG) and unsupervised oximetry at home in consecutive nights (randomized). An apnea-hypopnea index (AHI) from PSG ≥15 events/h was used to confirm OSA.
RESULTS. Table 1 summarizes the diagnostic performance of the algorithm in both test datasets. In the no-COPD group, 4 subjects were misclassified as OSA positive (2 borderlines and 1 with an at-home desaturation index significantly greater than that from PSG due to night-to-night variability) and 21 patients were misclassified as OSA negative (3 borderlines and 11 with an at-home desaturation index significantly lower than that from PSG due to night-to-night variability). Similarly, in the COPD group, 3 subjects were misclassified as OSA positive (2 borderlines) and 13 patients were misclassified as OSA negative (4 borderlines and 8 with an at-home desaturation index significantly lower than that from PSG due to night-to-night variability).
CONCLUSIONS. Unsupervised oximetry at home is an effective screening tool for OSA also in COPD patients.

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Table 1. Diagnostic performance of the SVM classifier trained with at-home unattended SpO_2 recordings in both no-COPD and COPD independent test datasets.

Group	Se (%)	Sp (%)	PPV (%)	NPV (%)	LR+	LR-	Post-test*	AUC	kappa
no-COPD	74.1	86.2	93.8	54.4	5.37	0.30	0.94	0.80	0.51
COPD	75.0	81.3	92.9	50.0	4.00	0.31	0.93	0.78	0.46

Se: sensitivity; Sp: specificity; PPV: positive predictive value; NPV: negative predictive value; LR+: positive likelihood ratio; LR-: negative likelihood ratio; Post-test: post-test probability; AUC: area under the ROC curve; kappa: Cohen's kappa coefficient

* OSA prevalence or pre-test probability for AHI ≥15 events/h: 0.74 in the no-COPD group and 0.77 in the COPD group