

# Sleep and breathing disturbances in patients with chronic obstructive pulmonary disease traveling to altitude: a randomized trial

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*Sleep*, Volume 42, Issue 1, January 2019, zsy203, <https://doi.org/10.1093/sleep/zsy203>

**Published:** 04 December 2018 **Article history** ▼

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## Abstract

### Study Objectives

Patients with chronic obstructive pulmonary disease (COPD) have impaired pulmonary gas exchange near sea level. The purpose of the current study was to investigate whether exposure to hypobaric hypoxia during a stay at altitude affects nocturnal oxygen saturation, breathing pattern, and sleep in patients with moderate to severe COPD.

### Methods

Thirty-two patients with COPD, median age 67 years, FEV1 59% predicted, PaO<sub>2</sub> 68 mmHg, living below 800 m, underwent polysomnography and questionnaire evaluations in Zurich (490 m), and in Swiss Alpine villages at 1650 and 2590 m, for two nights each, in random order. Mean nocturnal oxygen saturation (SpO<sub>2</sub>), the apnea–hypopnea index (AHI), and sleep structure were compared between altitudes.

### Results

Polysomnography during the first night at each altitude revealed a reduced SpO<sub>2</sub> at 1650 and 2590 m (medians 89% and 85%) compared with 490 m (92%,  $p < 0.05$  vs. higher altitudes) and a higher AHI (medians 26.8/hr and 55.7/hr) vs. 490 m (15.4/hr,  $p < 0.05$  vs. higher altitudes) due to emergence of frequent central apneas/hypopneas. At 2590 m, sleep efficiency (median 59%) and slow-wave sleep (median 17% of total sleep time) were reduced compared with 490 m (72% and 20%, respectively,  $p < 0.05$ ). In the morning after one night at 2590 m, patients estimated to have spent more time awake (median 110 min) than at 490 m (43 min,  $p < 0.05$ ) and felt slightly less alert.

### Conclusions

During a stay at moderate altitude, lowlanders with moderate to severe COPD experience nocturnal hypoxemia that induces central sleep apneas, altered sleep structure, and insomnia. These novel findings help us to counsel patients with COPD planning altitude travel.

### Trial Registration

ClinicalTrials.gov: NCT01870830

lung disease, COPD, hypoxia, altitude, sleep apnea, sleep, vigilance

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