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Letter to the Editor

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Nocturnal decrease of arterial oxygen content—hidden stimulus for erythropoietin secretion at altitude

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To the Editor:

In their investigation in male mountaineers in the Andes, Tannheimer *et al.*[1] showed that arterial oxygen saturation (S_aO_2) during undisturbed night sleep increased from a nadir during the first half to a higher value during the second half and a maximum in the morning after wake-up. The difference diminished with acclimatization and ascent from 3050 m to 5630 m of altitude during 19 days but remained significant. Unfortunately, the time of day was not communicated.

Measurements of diurnal variation in S_aO_2 at altitude are rare. Apparently, investigations in sojourners have been published only twice (reviewed in[1]). In addition to altitude acclimatization physical training by repeated ascents might play a role in the improvement of S_aO_2.

In highlanders at 4380 m above sea level, Spicuzza *et al.*[2] found a nadir of 83% S_aO_2 during the night (01:00–03:00) compared with ~86% in the awake state which was markedly higher than in the sojourners after 5 days at equal altitude (~79% and 81%). In a similar investigation in untrained highlanders in Colombia at 2600 m above sea level,[3] we have recently described a comparable variation of S_aO_2 with nadir also at 01:00–03:00 (91% in males, 93% in females) and subsequent rise to relatively stable values between 06:00 and 20:00 (~93% and 95%, respectively). The most interesting result was a significant negative correlation between the variations in arterial oxygen content and erythropoietin concentrations in blood 1-3 h later. This fits the known control circuit. A lowered arterial oxygen content reduces tissue PO_2 in the kidneys and stimulates erythropoietin secretion in this organ with a delay of 80–120 min.[4,5]

Interestingly, all night S_aO_2 values even after acclimatization in Tannheimer *et al.*'s[1] paper are below the limit of 93% where the oxygen dissociation curve becomes steeper and therefore the increase of red cell mass because of decreasing PO_2 is augmented. Below this value, the stimulation of erythropoietin secretion by the kidneys remains active.

Additional measurements in trained subjects were not included in our paper because of incomplete erythropoietin data, but S_aO_2 varied equally like in the nonathletes. The cause for the variation in S_aO_2 is the lowered ventilation during the night. Whether this results from endogenous rhythms in the brain centres for respiratory stimulation or is a secondary effect of varying cortisol secretion as suggested by Tannheimer *et al.*[1] remains unsolved.

Tannheimer *et al.*[1] focus on acute altitude acclimatization measured by the Lake Louise Score. A lacking increase of S_aO_2 from night to morning was related to a bad score. The interesting interrelationship between their paper and our study is that the sustained rise of haemoglobin mass in spite of the disappearance of increased erythropoietin concentration (Epo) during daytime with ongoing acclimatization was unexplained until recently. Now it is clear that during short-lasting as well as during life-long stays at altitude, there is an additional night decrease of arterial oxygen content that stimulates Epo secretion during this phase and contributes to the increase of Hb mass.

Conflict of interest: None declared.

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