

# There is no scientific argument to discard the sleep item from the Lake Louise score

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# The Lake Louise score

The Lake Louise AMS Score (LLS) is widely used in field studies for the diagnosis of AMS.

This score aggregates symptoms that are ALL unspecific:

- headache,
- digestive symptoms,
- fatigue, weakness,
- dizziness , light-headedness,
- sleep disturbances

All symptoms can be due to a variety of causes unrelated to altitude hypoxia. Acetazolamide can mimic AMS.

+ AMS clinical functional score = very useful in the field

# The Lake Louise score- 2018 version

It was recently suggested removing sleep disturbances from the score, for various reasons:

- not applicable for short term studies (hypobaric or normobaric chambers)
- extremely unspecific
- not related to headache or other symptoms in some studies (MacInnis et al., 2013; Hall et al., 2014)

## McInnis et al. study

- 491 Nepalese pilgrims between 1950 and 4380m: sleep weakly related to other items, *but...*
- No control of medication either occidental or traditional drugs or alcohol use, that may have a differential impact on headache, sleep disturbances, digestive symptoms, etc...

## Hall et al. study

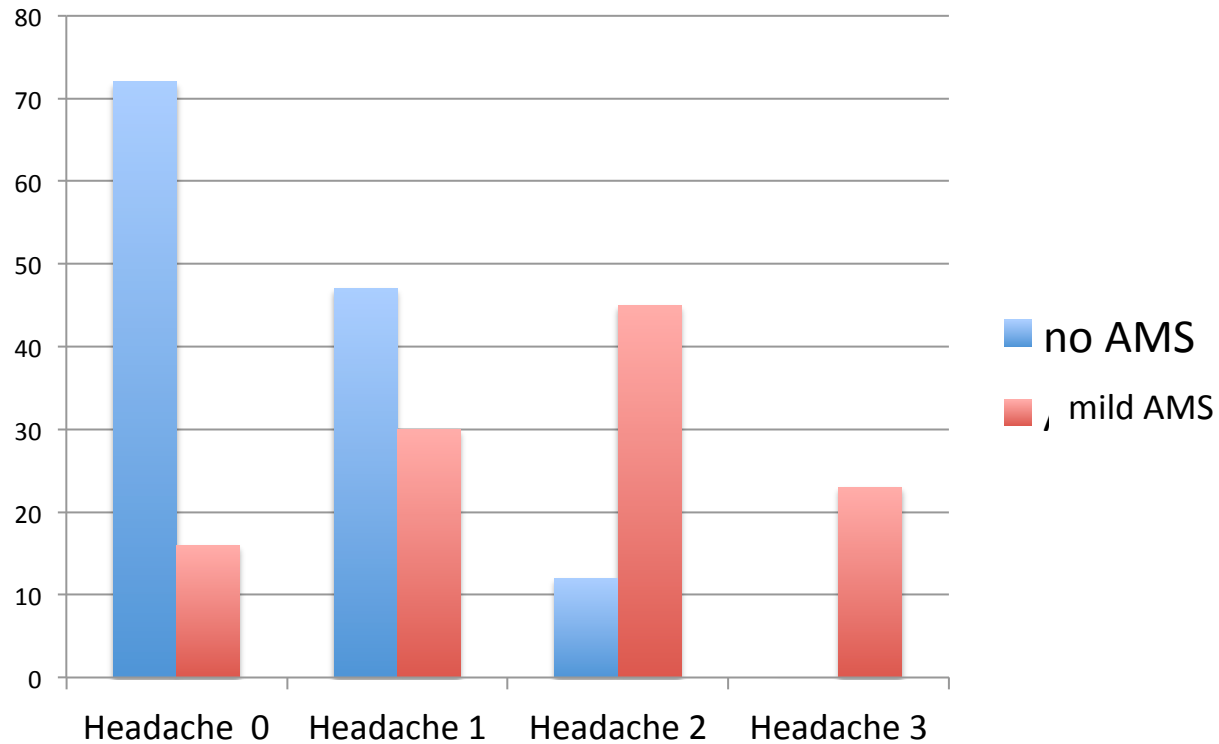
- Two merged experimental conditions (subjects from a scientific expedition in Bolivia and trekkers ascending Kilimanjaro) in a total of 292 subjects.
- They evidenced three different patterns of symptoms, associating or not headache, fatigue and sleep disturbances. They also found that sleep disturbance correlated poorly with the other symptoms. *But....*
- Drug use was not controlled in most subjects: no control at all in the Kilimanjaro group, only 42 subjects on placebo in the Bolivia group.
- There is no statistical evidence that their results apply to this last group, although the authors try to increase their statistical power by pooling various measurements at different times for the same subject, which is not correct from a statistical point of view.

# Material, methods and objectives

- We analyzed LLS from 317 trekkers at high altitude, **taking no medication**.
- Among them 119 suffered from mild AMS (mAMS:  $3 \leq \text{LLS} < 6$ ), 64 from moderate to severe AMS (sAMS:  $\text{LLS} \geq 6$ ).
- The objective was:
  - 1) re-evaluate the need for a headache score  $> 0$  for the diagnosis of AMS,
  - 2) evaluate the role of sleep disturbances, in relation with other symptoms,
  - 3) evaluate the significance of dizziness.

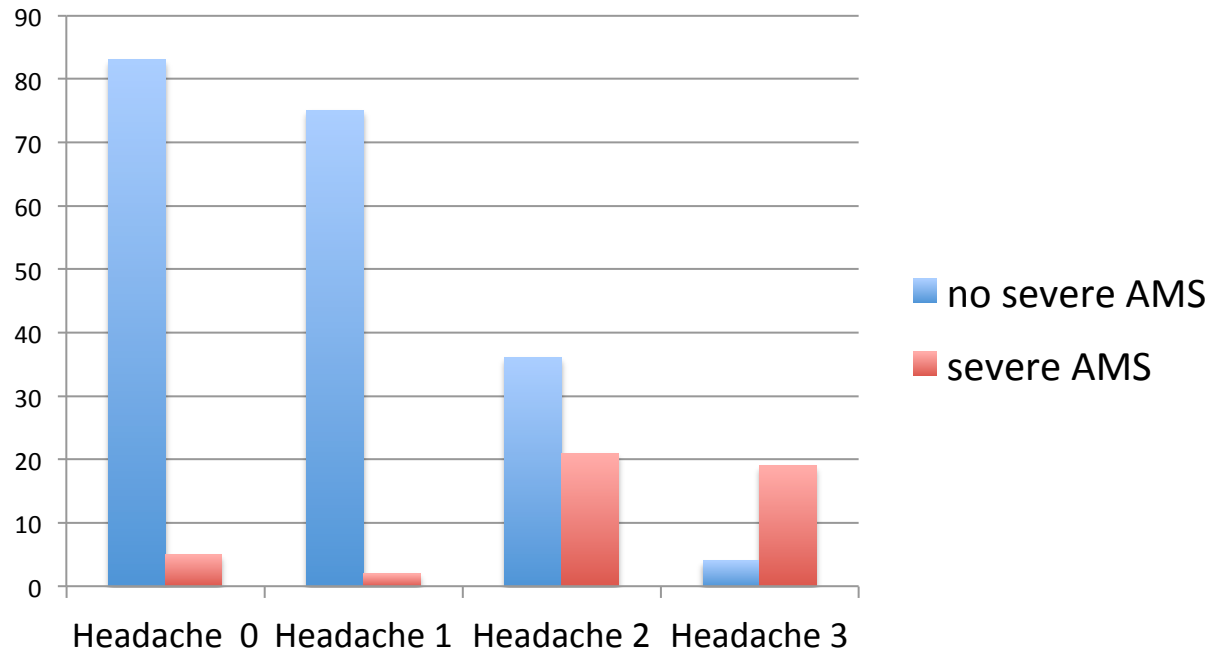


## Nb of subjects in each group



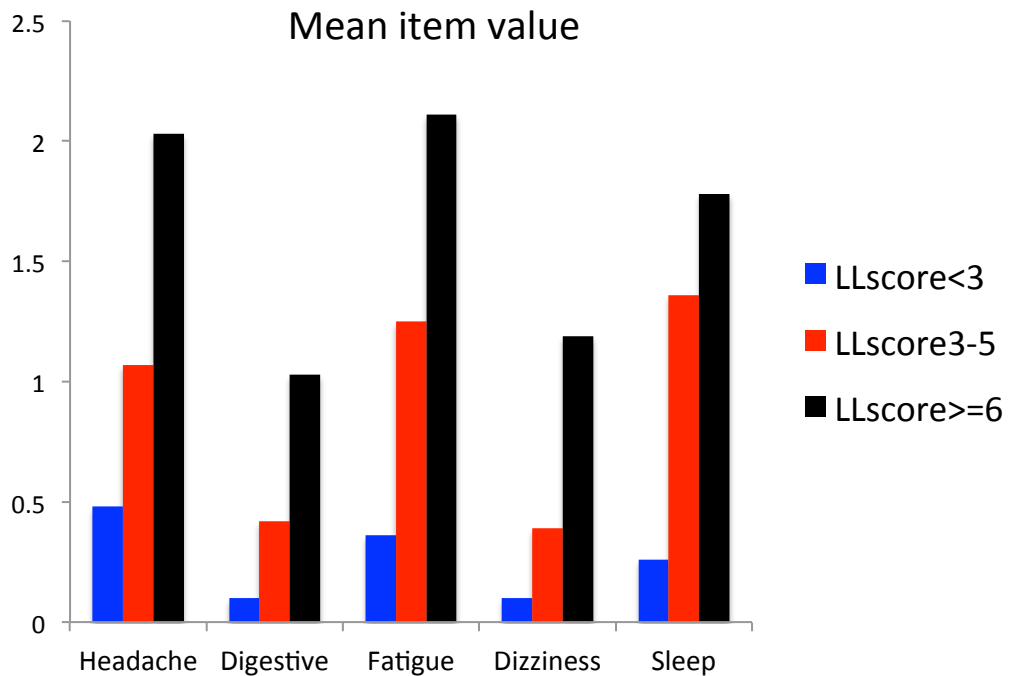
In a subgroup of our cohort, 131 AMS- and 114 mAMS+, 16 subjects with AMS+ (14%) had a headache score of 0 ! None of AMS- subjects had a headache score of 3. mAMS+ was defined as total score  $\geq 3$  and  $< 6$

## Nb of subjects in each group



In a subgroup of our cohort, 196 sAMS- and 47 sAMS +, 5 subjects with severe AMS (11%) had a headache score of 0 !

Severe AMS was defined as total score > or =6



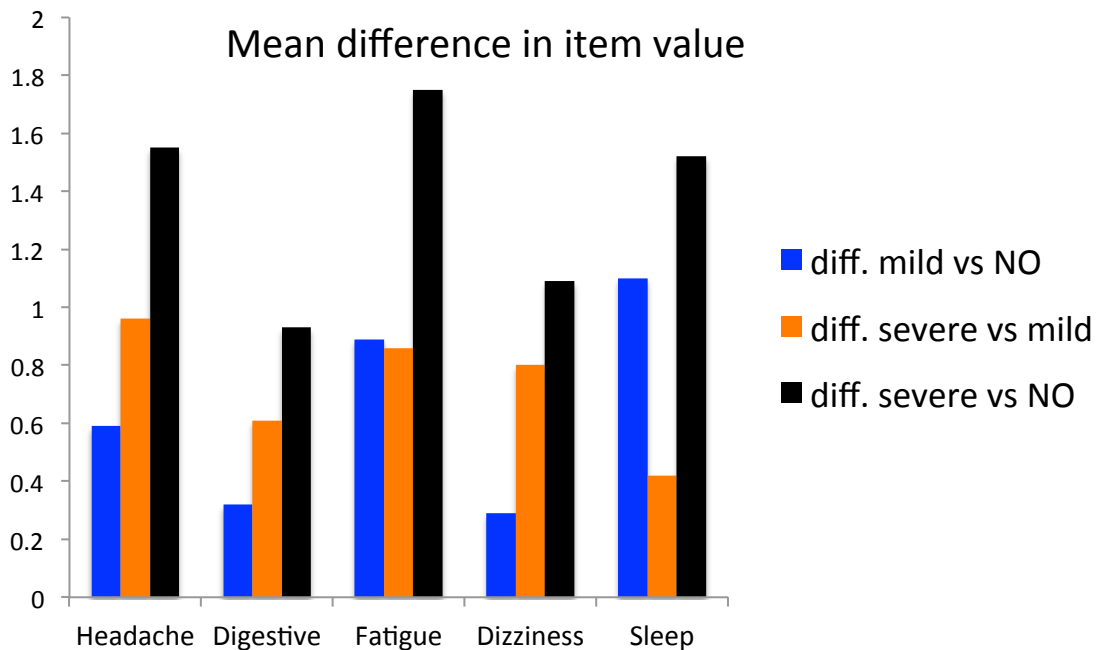
## Main contributors

### Mild AMS:

- Headache
- Fatigue
- Sleep

### Moderate/severe AMS:

- Headache
- Fatigue
- Sleep



### To differentiate mild vs moderate/severe:

- Headache
- Fatigue
- Dizziness



# Analysis of variance

- **Mild AMS:**

- Sleep:  $F=9.57, p<0.001$
- Fatigue:  $F=7.73, p=0.001$
- Headache:  $F=6.10, p=0.005$
- Dizziness:  $F=2.27, p=0.08$
- Digestive:  $F=0.35, p=0.79$

- **Moderate/severe AMS:**

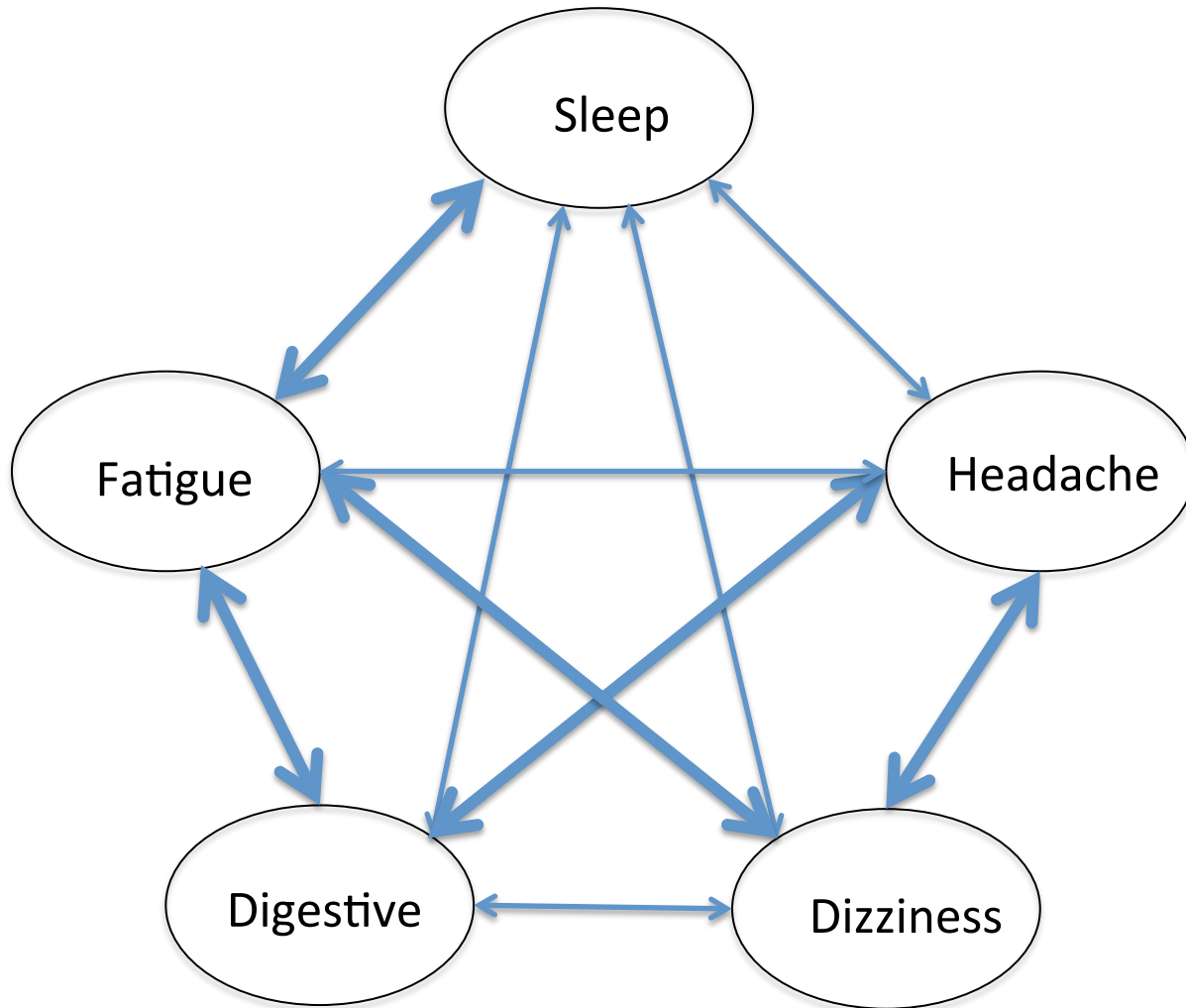
- Headache:  $F=33.5, p<0.001$
- Dizziness:  $F=15.6, p<0.001$
- Fatigue:  $F=14.6, p<0.001$
- Digestive:  $F=7.20, p=0.001$
- Sleep:  $F=6.57, p=0.003$

# Factor analysis

## Inter-item correlation matrix

	Headache	Digestive	Fatigue	Dizziness	Sleep
Headache	1				
Digestive	<b>0.3417</b>	1			
Fatigue	0.1850	<b>0.3204</b>	1		
Dizziness	<b>0.2798</b>	0.2301	<b>0.3714</b>	1	
Sleep	0.1635	0.1392	<b>0.3431</b>	0.1587	1

n=317 (whole population)



# Number of subjects with mild AMS with 0 at item or item couple

	Headache	Digestive	Fatigue	Dizziness	Sleep
Headache	37 (27%)				
Digestive	29	88			
Fatigue	6	20	30		
Dizziness	27	54	22	92	
Sleep	6	20	10	25	40

n=138 (mild AMS)

**Digestive** and **dizziness** are the most frequent absent symptoms

# Number of subjects with moderate/severe AMS with 0 at item or item couple

	Headache	Digestive	Fatigue	Dizziness	Sleep
Headache	6 (9.4%)				
Digestive	1	14			
Fatigue	0	1	6		
Dizziness	2	5	4	19	
Sleep	0	1	1	1	9

n=64 (moderate/severe AMS)

Association of Headache **AND** Fatigue or Sleep is specific

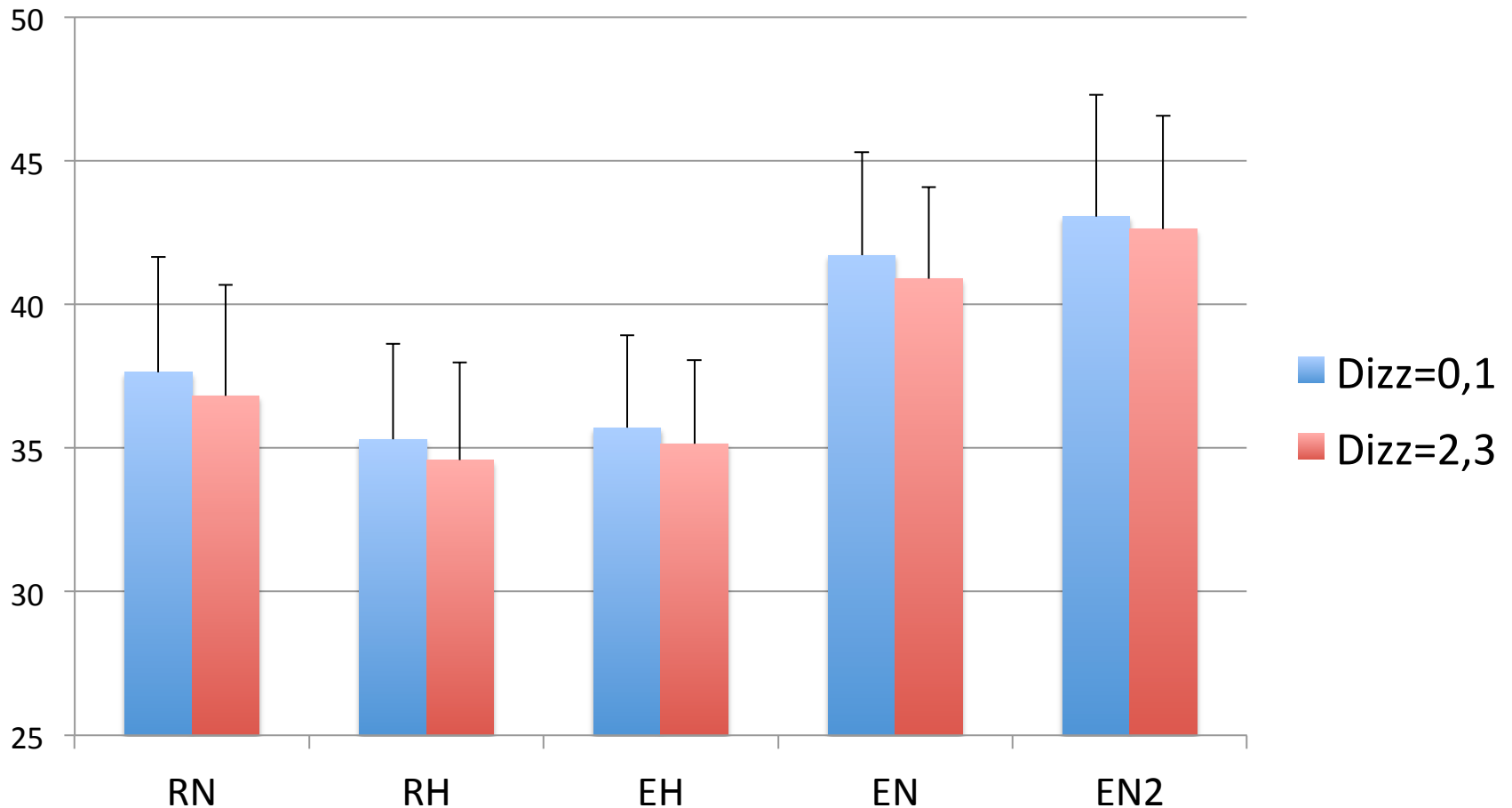
**Digestive** and **dizziness** are the most frequent absent symptoms

# Effect of deleting sleep item

<i>Nb of subjects</i>	With sleep item	Without sleep item
Mild AMS	138	120 (-13%)
Moderate/severe AMS	64	48 (-25%)

# End-tidal PCO<sub>2</sub> during standard Hypoxic Exercise Test

mmHg

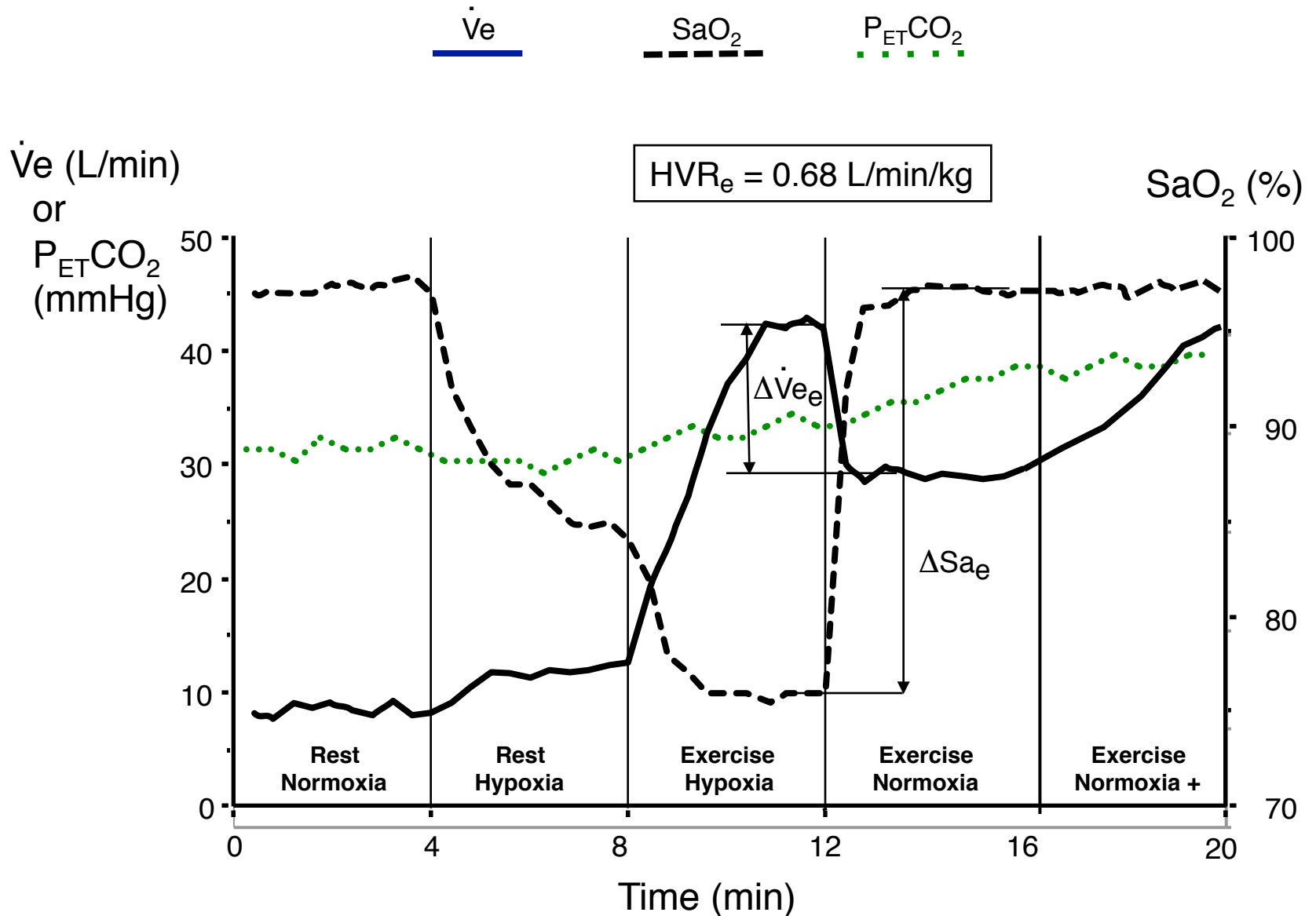




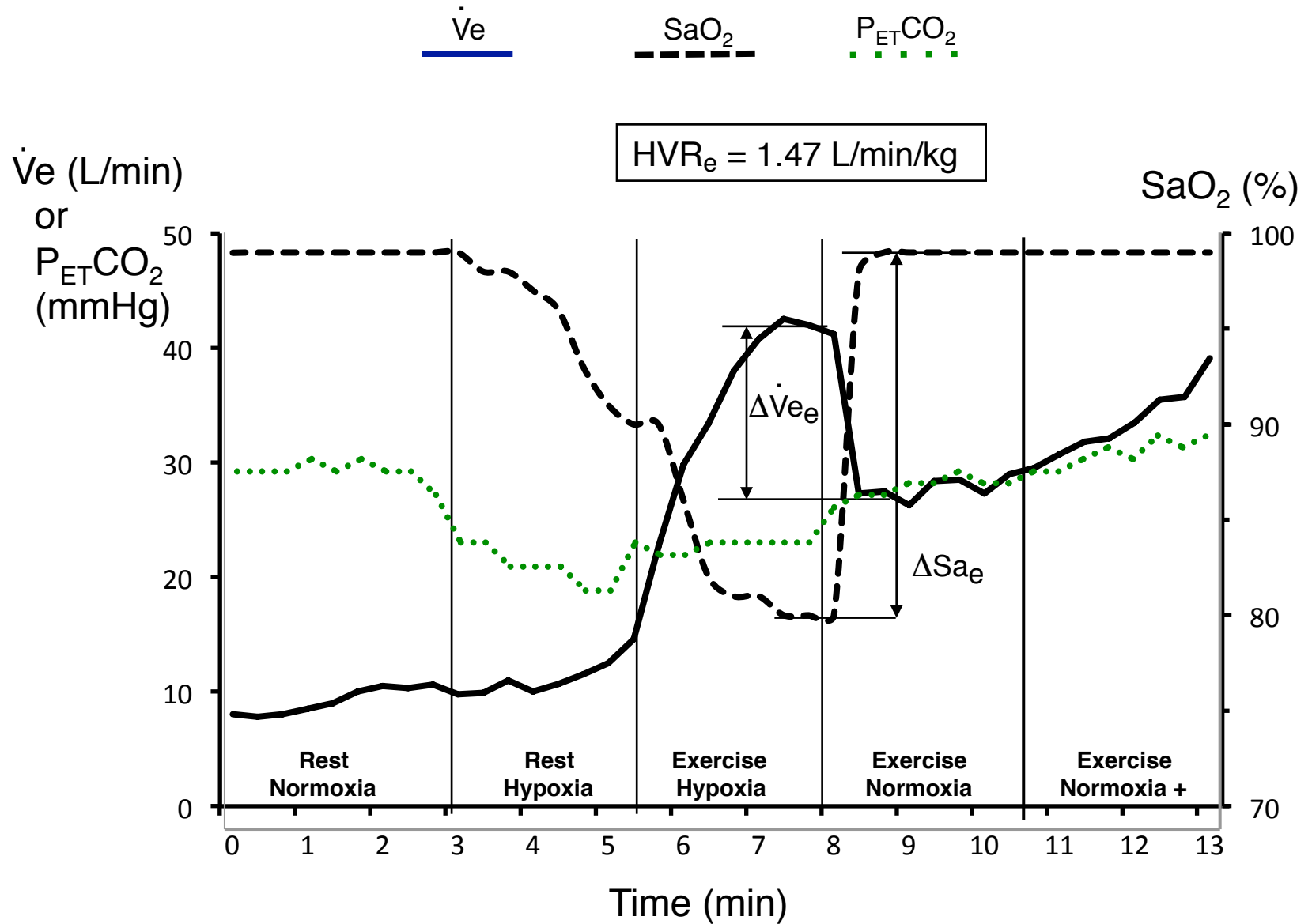
# Case report : transient cerebral ischemia

- A 36-year old woman with no previous medical history, participated in a trekking in Ladakh up to 5300m of altitude. She was well acclimatized and presented no previous sign of AMS, HAPE or HACE.
- After an intense effort to catch up with her group, she became breathless and complained of visual disturbances, fatigue, dizziness and confusion.
- During her descent to a lower altitude (4800m), with the help of companions, she lost consciousness several times.
- After a 14h sleep, she recovered and all symptoms disappeared so that she was able to walk along with the group for 20 kms.
- At returning home, she went through a battery of exams that were all normal: cerebral MRI, Doppler of supra-aortic arteries, 24h Holter, cardiac transthoracic and transesophageal echography.
- A Hypoxia Exercise Test revealed a hyper-response to hypoxia with severe hypocapnia.

# Hypoxic exercise test: control subject



# Hypoxic exercise test: case



## Case report : transient cerebral ischemia

- The most probable diagnosis is a **transient cerebral ischemia** due to local cerebral vasoconstriction related to hyperventilation-induced hypocapnia in a context of acute severe exercise.
- Special attention should be given to subjects who show a **hyper-responsiveness to hypoxia** prior to a sojourn at high altitude: they should avoid unnecessary hyperventilation due to any kind of stress, emotion or exhaustive exercise.

# Conclusion

- 1) an isolated headache score  $>0$  should not be mandatory to define AMS,
- 2) absence of headache AND absence of fatigue OR sleep is specific of absence of mod/severe AMS
- 3) headache, fatigue and sleep are the main contributors in the diagnosis of severe AMS,
- 4) no evidence for sleep disturbances being unrelated to others in a large cohort of subjects **WITHOUT** medication
- 5) dizziness might be confused with headache or be linked to an hyper-response to hypoxia.

# Recommendation

- LL score is not perfect (as all scores based only on subjective symptoms)
- It would be helpful to use other scores in parallel (AMS-C score, etc...)
- We should continue to use the original LL score in field high altitude studies.
- People doing acute studies (<24h) could use a LL score without the sleep item.