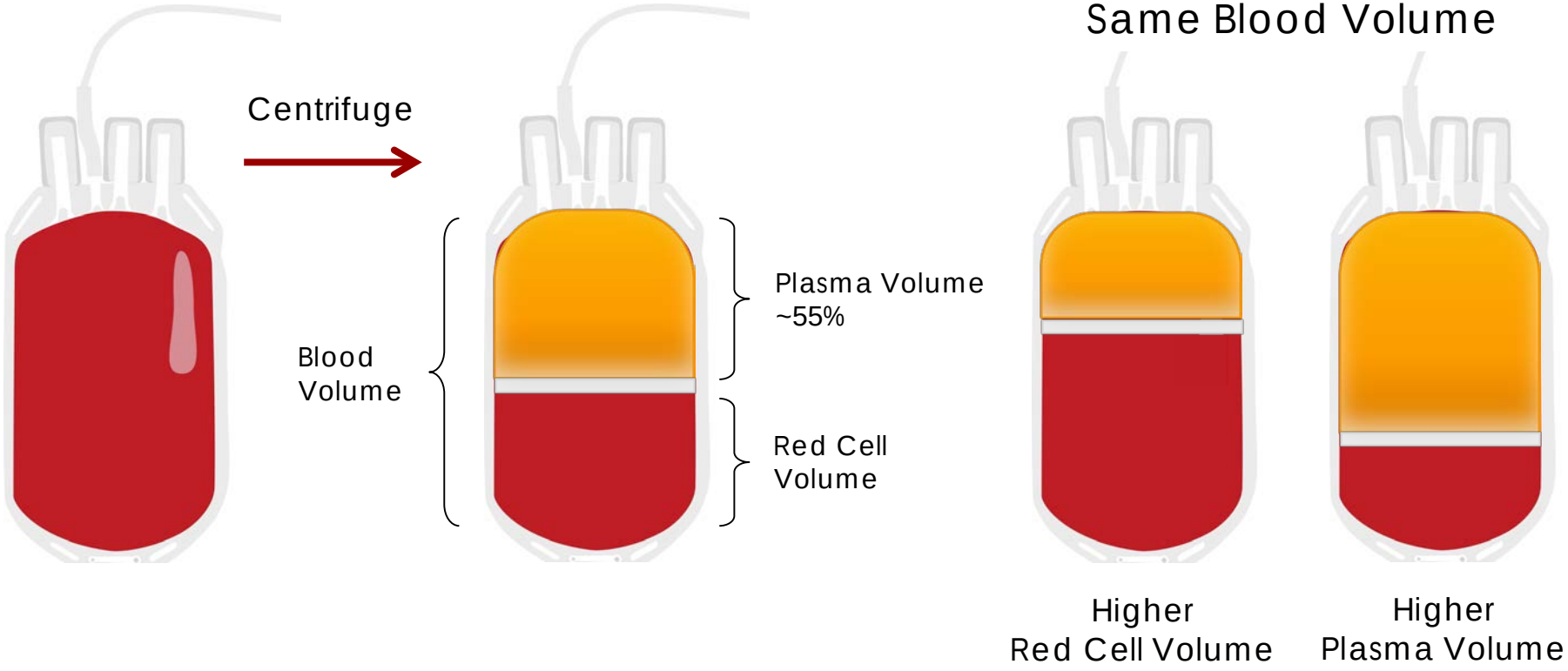
Plasma Volume, Altitude & the ABP

Louisa Lobigs
University of Western Australia

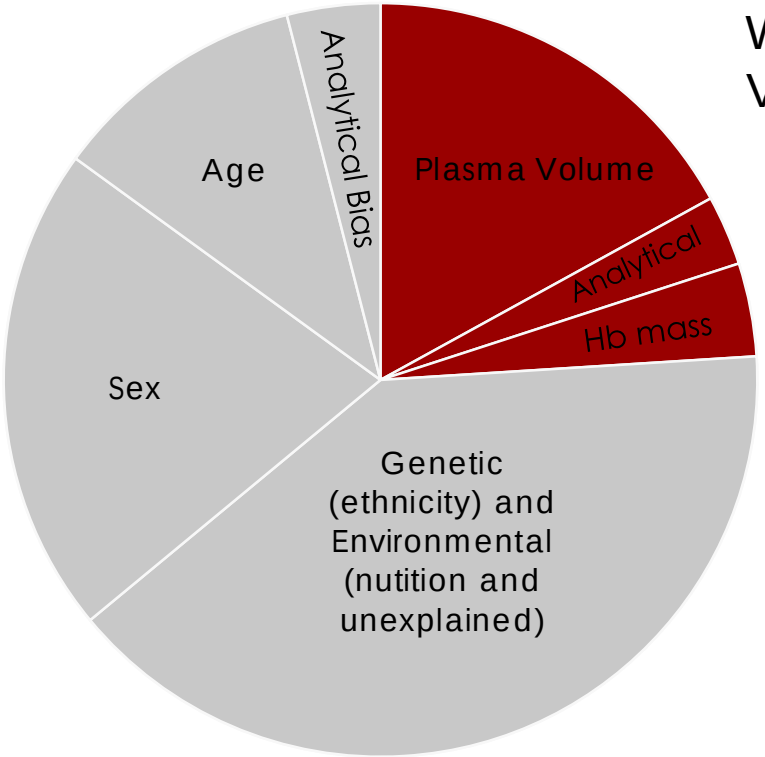
Overview

- Components of blood
- Biological variance and the ABP
- Plasma volume and exercise
- Altitude
- What magnitude of change can be expected
- How do we respond?

What makes up whole blood?



Variance components of [Hb]

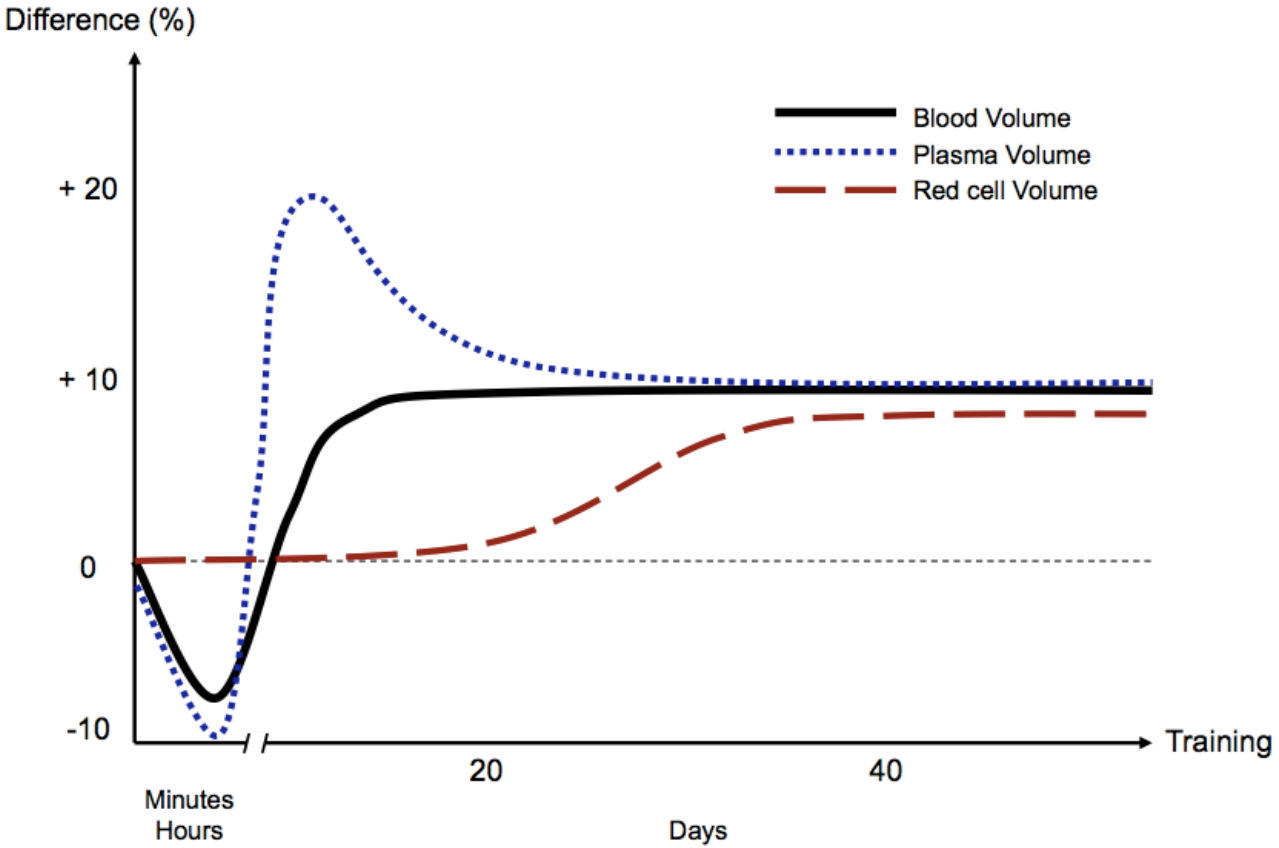


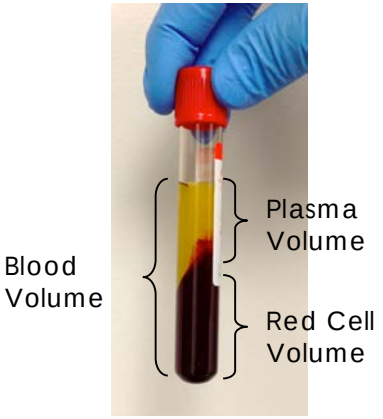
Within-subject Variation

Between-subject Variation

Adapted from Sottas et al., Transl Res, 2011 and Lobigs et al., Eur J Sports Sci, 2018

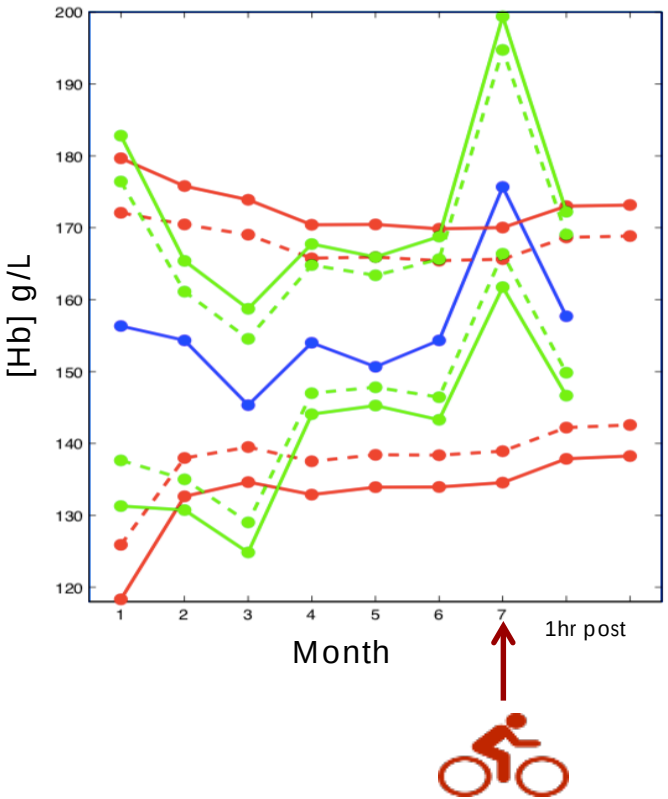
Plasma volume & exercise

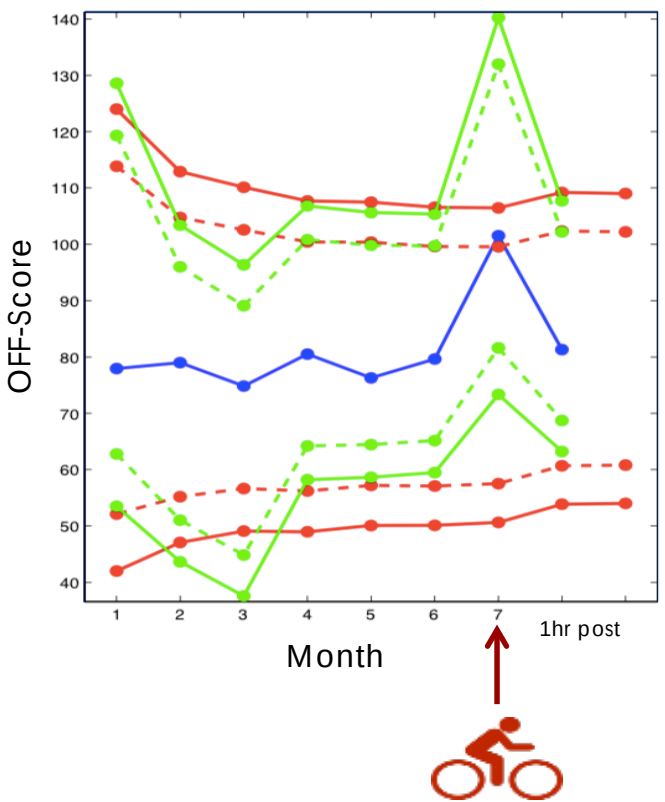




Adapted from Sawka M., et al., Med Sci Sports Exerc, 2000

Plasma volume & acute exercise





Post exercise:

[Hb] +20 g/L (+13%)

OFF-score +20 units

Plasma volume - 576mL (-20%)

Retic# no change

Adapted from Lobigs., et al., Am J Haematol, 2017

Plasma volume & chronic exercise

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ORIGINAL ARTICLE

WILEY

Plasma volume reduction and hematological fluctuations in high-level athletes after an increased training load

J. Bejder[1] | A. B. Andersen[1] | J. P. Goetze[2] | N. J. Aachmann-Andersen[3] | N. B. Nordsborg[1]

250% increase in training volume for 1 week:

Plasma volume 10% increase

[Hb] ~6% decrease

OFF-hr ~16% decrease

Return to baseline: 2 days (PV) and 4 days ([Hb])

Observed atypical passport profiles

Plasma volume & multi-day racing

Table 1. Review of the hematological changes observed during endurance cycling events.

Tour	N	Collection Time (days)	[Hb] (g/L)	HCT (%)	RET%	Plasma volume (%)	Blood volume (%)	Reference
Giro d'Italia 1987 (22 stages)	15	10	-4					(Campanini et al., 1988)
		20	-11					
Vuelta a España 1998 (22 stages)	16	9	-11	-2.6				(Chicharro et al., 2001)
		15	-12	-2.8				
		22	-13	-3.2				
Giro d'Italia 2011 (21 stages)	9	12	-13	-3.1	0.18 *	1.6 #		(Corsetti et al., 2012)
		22	-9	-2.1	0.19 *	0.9 #		
Tour Down Under 2009 (6 stages)	6	3	-11.8	-3		13		(Garvican et al., 2010)
		6	-14.9	-4		17		
Simulated cycling tour ** (14 stages)	12	6	-12	-3.4	-0.09	14.5		(Garvican-Lewis et al., 2014)
		9	-6.4	-2	-0.04	8.1		
Tour of Niedersachsen 1989 (10 stages)	4	2	-7	-2.0		9.1		(Schmidt et al., 2000)
		3	-11	-3.8		15.9		
		4	-10	-3.4		14.0		
		5	-13	-4.6		19.7		
		6	-16	-5.2		23.0		
		7	-12	-4.4		17.7		
		8	-13	-4.5		18.9		
		10	-14	-5.1		21.8		
		+2	-7	-1.9		6.0		

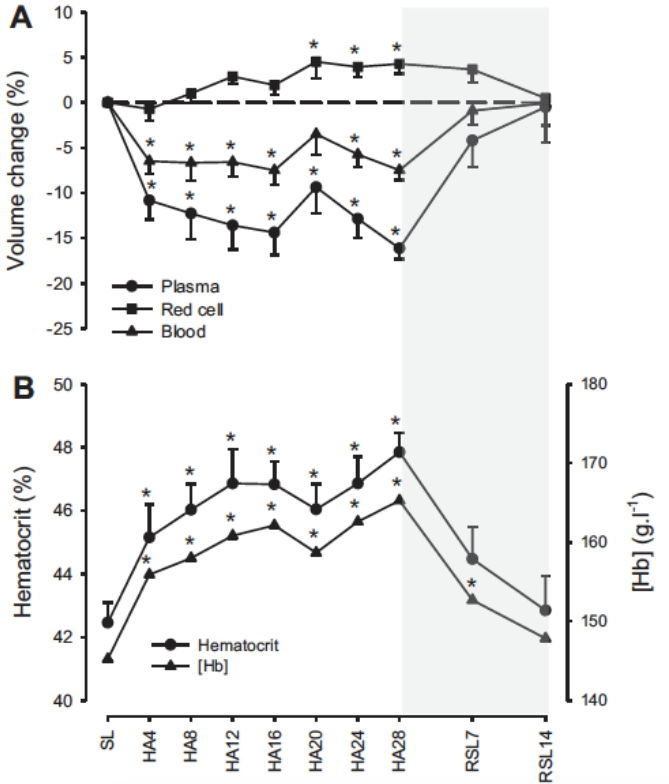
Adapted from Lobigs., et al., Eu J Sports Sci, 2018

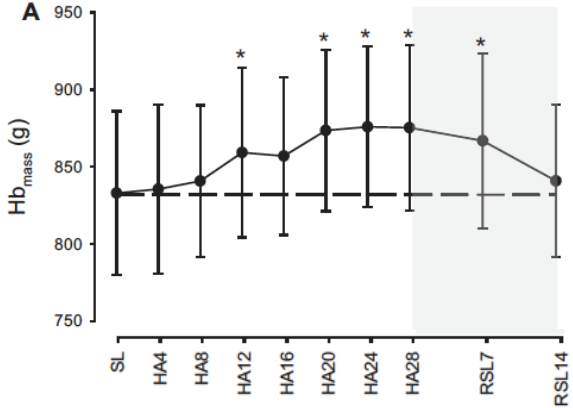
Why train at altitude?

St Moritz, Switzerland

1,822 m

Altitude & the ABP

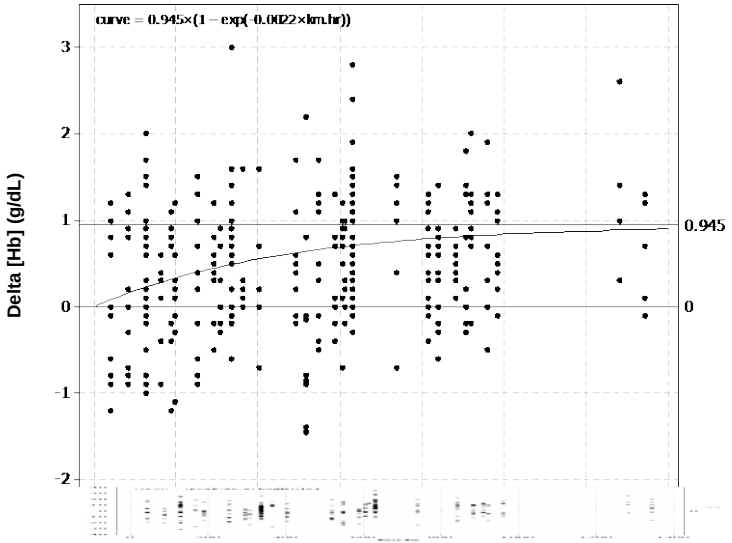


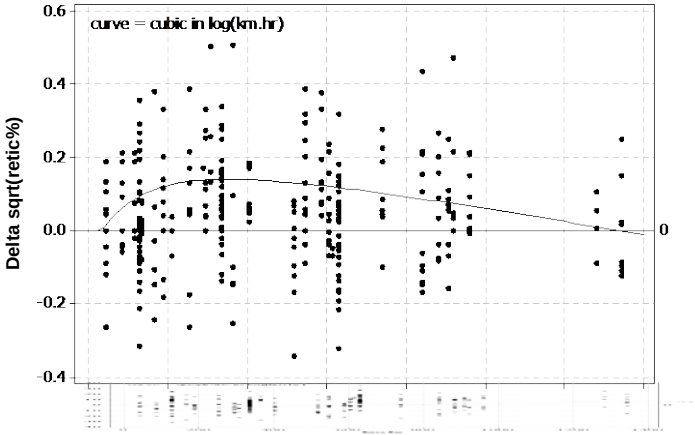


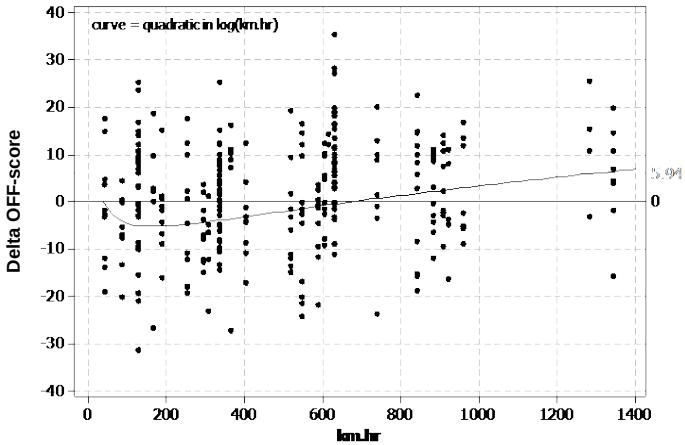
Altitude: 3484 m
28 days

Siebenmann C., et al., J Appl Physiol, 2015

During altitude







Figures **do not include the first 2 days** at altitude.

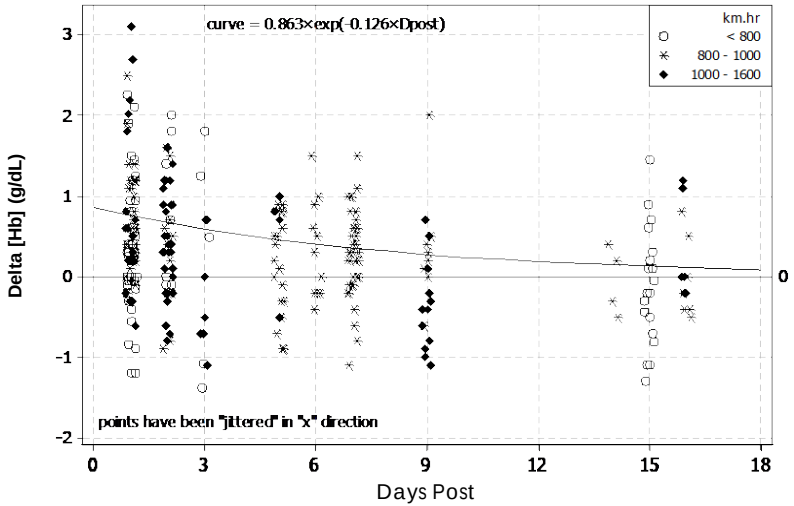
Lobigs L., et al., Am J Haematol, 2018

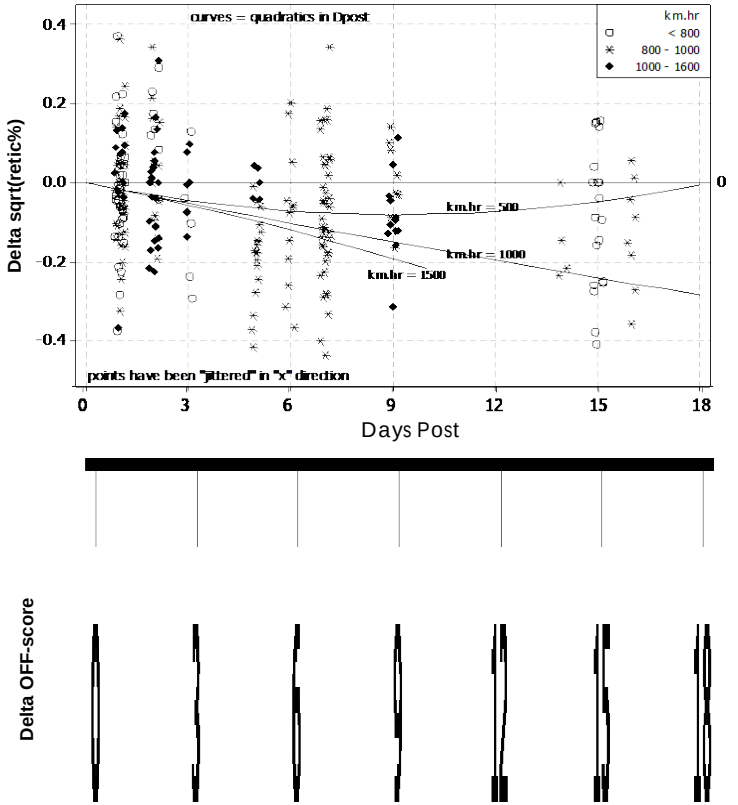
Extreme changes during altitude

DURING	All	Min, Max
[Hb]* (*n* = 258 M, 87 F)	≤ −1.2 (4)	−1.5, 3.0
	≥ 2.6 (3)[a]	
sqrt(retic%) (*n* = 222 M, 73 F)	≤ −0.315 (3)[a]	−0.343, 0.508
	≥ 0.472 (3)	
OFF-score (*n* = 204 M, 73 F)	≤ −26.8 (3)[a]	−31.4, 35.4
	≥ 27.1 (3)	

Adapted from Lobigs L., et al., Am J Haematol, 2018

Post altitude – the return to baseline





Lobigs L., et al., Am J Haematol, 2018

How do we respond?

- Plasma volume marker
- Research into multi-day events
- How long does it take to return to baseline after altitude?

Questions?