ALTITUDE TRAINING FOR HIGH LEVEL CYCLING

INTERNATIONAL SYMPOSIUM
OF ALTITUDE TRAINING
February 14th to 16th, 2008
GRANADA - SPAIN

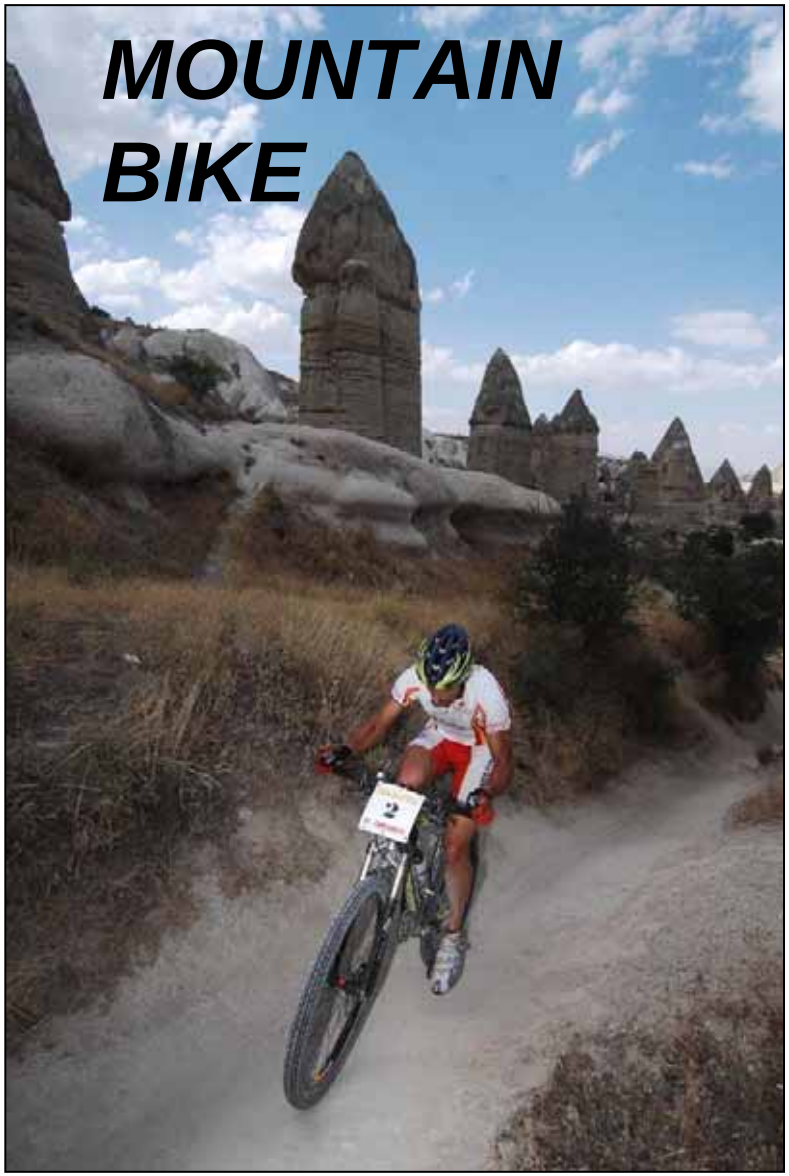
www.sierranevada-altitudetraining.com

Dr. MIKEL ZABALA DÍAZ (PhD)
Spanish Cycling Federation
University of Granada
director.tecnico@rfec.com - mikelz@ugr.es

CYCLING – wide range of disciplines

TRIALS

MOUNTAIN BIKE

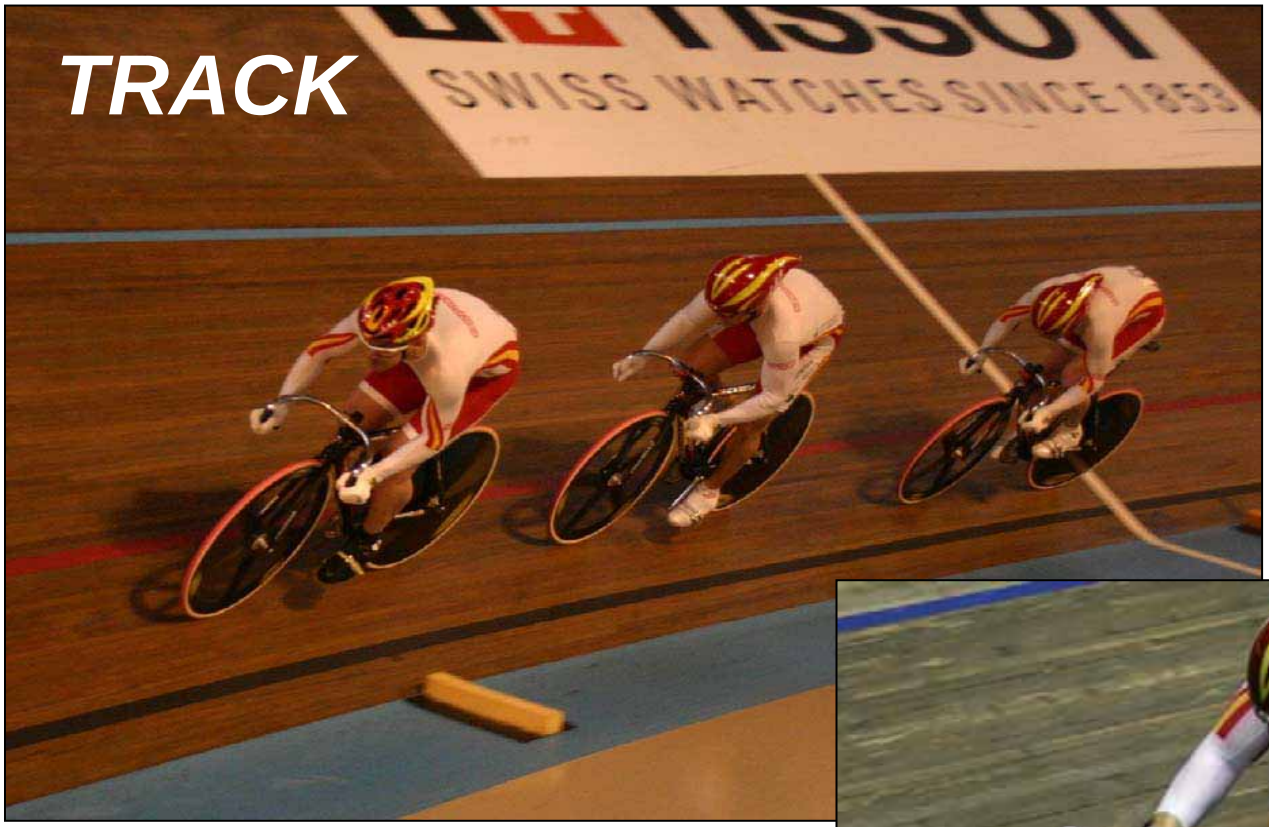


DOWN HILL

FOUR CROSS

ROAD

TRACK



TRACK

TRACK CYCLING WORLD RECORDS

MEN	TIME/DIST	CYCLIST(S)	TEAM	DATE	PLACE	COMP.
200 m SS*	9"774	Theo BOS	Holland	15-dic-06	Moscou (RUS)	World Cup
500 m LS**	24"758	Chris HOY	Great Britain	13-May-07	La Paz (Bolivia)	Record attempt
1 Km	58"875	Arnaud TOURNANT	France	10-Oct-01	La Paz (Bolivia)	Record attempt
4 Km	4'11"114	Christopher BOARDMAN	Great Britain	29-ago-96	Manchester (GBR)	World Champ.
4 Km Team	3'56"610	G. Brown – P.Dawson -- L. Roberts B.Lancaster – B. Macgee	Australia	22-Ago-04	Athens (GRE)	Olympics
1 hour	49,700 Km	Ondrej SOSENKA	Czech Rep.	19-Jul-05	Moscou (RUS)	1h Record
1 hour	56,375 Km	Christopher BOARDMAN	Great Britain	06-sep-96	Manchester (GBR)	1h Record

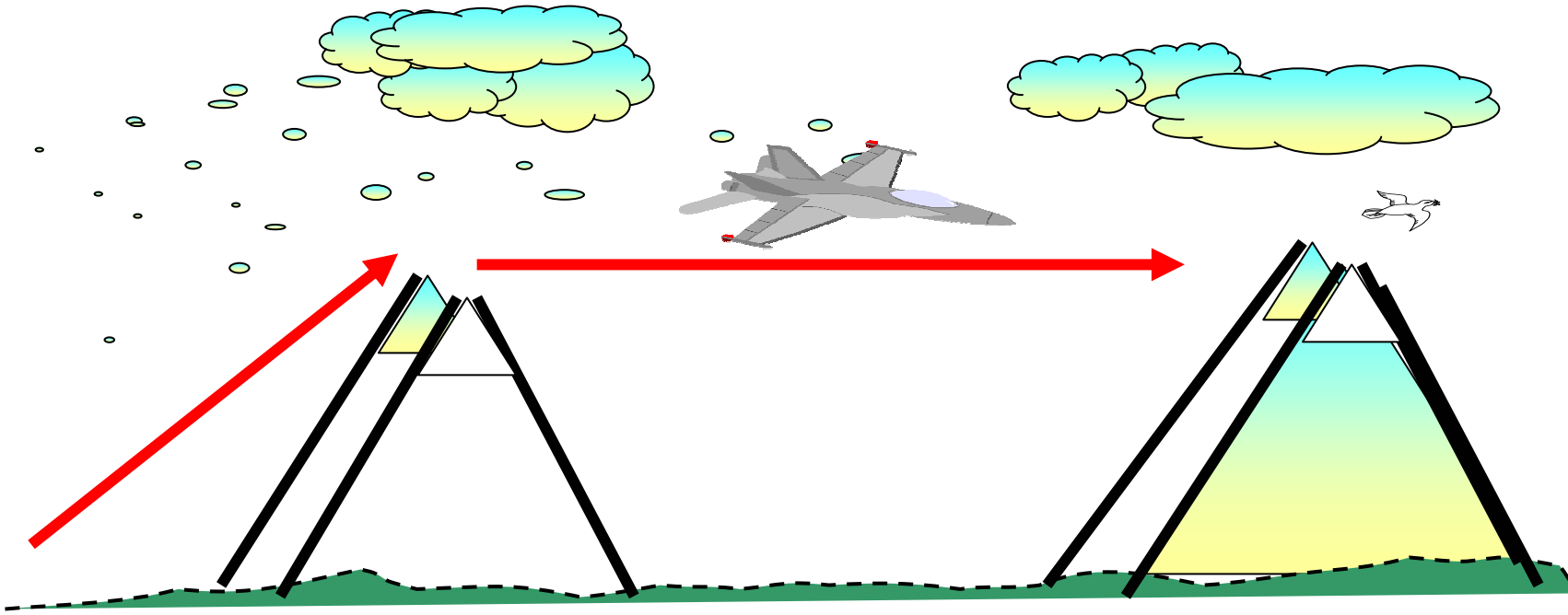
WOMEN	TIME/DIST	CYCLIST(S)	TEAM	DATE	PLACE	COMP.
200 Mts.LS**	10"831	Olga SLIUSSAREVA	Russia	25-abr-93	Moscou (RUS)	Meeting
500 Mts. LS**	29"655	Erika SALOUMIAEE	Russia	06-ago-87	Moscou (RUS)	Olympics
500 Mts. SS*	33"588	Anna MEARES	Australia	31-Mar-07	Palma Mallorca	World Champ.
3 Km	3'24"537	Sarah ULMER	New Zealand	22-Ago-04	Athens (GRE)	Olympics
1 hour	46,065 Km.	Leontien ZIJLAARD (Van Moorsel)	Holland	1-Oct-03	Mexico	1h Record
1 hour	48,159 Km.	Jeannie LONGO – CIPRELLI	France	26-oct-96	Mexico	1h Record

*SS: Standing Start / **LS: Launched Start

Why train in altitude?

Why train in altitude?

1) ACCLIMATISATION



2) GAIN OF PERFORMANCE AT SEA LEVEL

3) TO MASK OR DISGUISE THE USE OF EXOGENOUS EPO

Other objectives:

Socialization

Team Building

Training environment

Why train in altitude?

Aerobic Capacity is very important also for the shorter disciplines

Benefits:

Erythropoietic response (Robach et al., 2006) but also

by a multifactor cascade of responses (Gore et al., 2007).

Effects of short-term acclimatization Burtscher et al. (2006)

At 3200 m anaerobic cycling performance (30s maximal effort) was not affected

while aerobic performance was reduced by 12% and 11.3% for efforts of 5 and 50 min respectively

After 3 days the decrease in performance can recover 50% of the initial loss of a 50 min cycling.

Gain in performance after HT: 1% as an average (Hahn and Gore, 2001)
when at Olympic level often the differences are less than 0.5% (Wilber, 2007)

Statistical Difference vs Practical Difference (Atkinson, 2003)

LHTH and LHTL around 2500m are popular practices in cyclists
(Hahn and Gore, 2001)

Sleeping at 2650-3300 m for up to 23 days may offer practical benefit
but not due to increased Haemoglobin mass or VO_{2max} (Hahn et al., 2001)

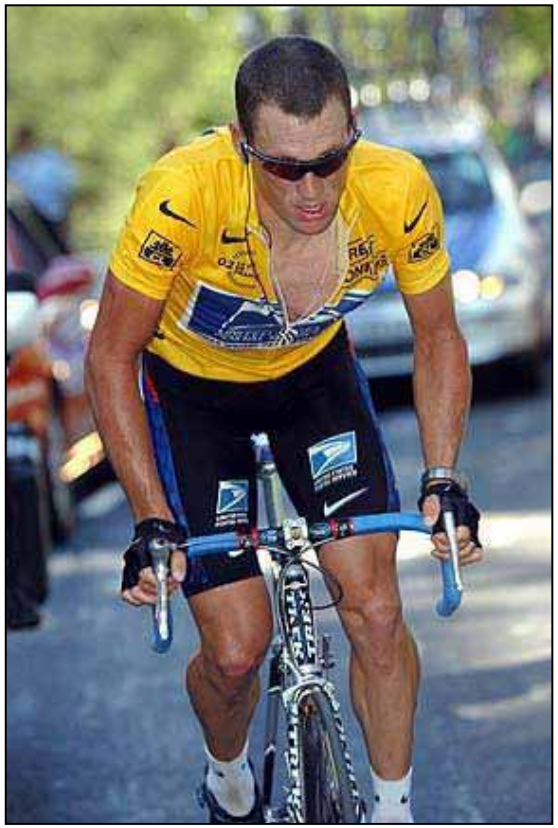
It is not generally recommended to train hard in altitudes higher than 3000 m
(Brugniaux et al., 2006)

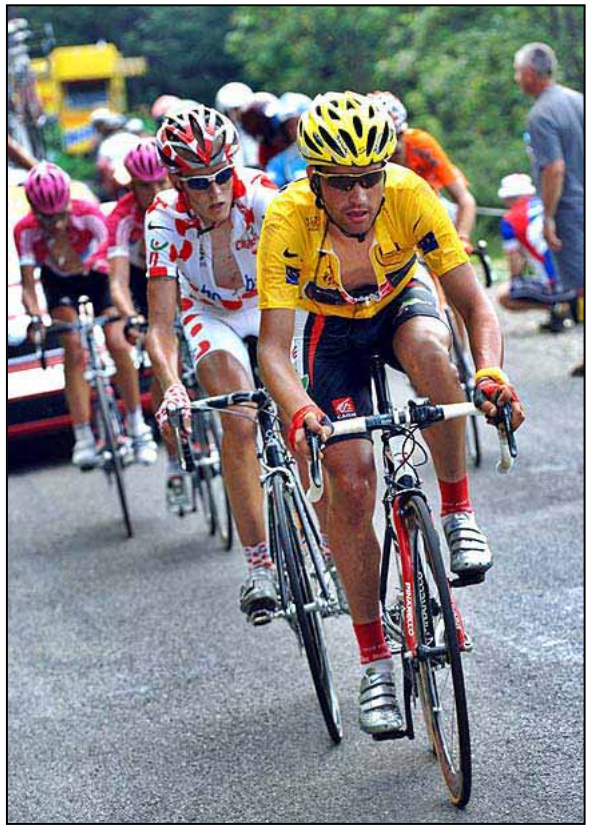
LHTL is the most recognized and used model of natural HT, although LHTH has been also widely used

i.e. Lance Armstrong in Teide Volcano or Alps

Mountain bikers many times compete at 2000-3000 m altitude where peak oxygen consumption declines approximately 10-20%
(Clark et al., 2007)

And these are also critical points in Road racing (i.e. Tour de France)





Competing the same day of the race without acclimatisation sometimes don't affect physiologically or in coordination patterns (Mornieux et al., 2007), BUT subjects tend to mis-pace their effort if it is the first time they perform (Clark et al., 2007) -when Junior cyclists compete for the first time at altitude-

First place all the race and crash in the last lap. Second at the end (the winner from Colorado USA)

LHTL method (Levine and Stray-Gundersen, 1997) depends on (Levine and Stray-Gundersen, 2006):

1) living high enough, for enough hours/day, for a long enough period of time,
2) training low enough to allow maximal quality of high intensity workouts requiring high rates of sustained oxidative flux

Recommended for LHTL 2000-2500 m of natural elevation for at list 4 weeks and 22 hours a day (Wilber et al., 2007).

LLTH model can weakened the antioxidant capacities of the athletes (Pialoux et al., 2006).

HT ADMINISTRATIONS

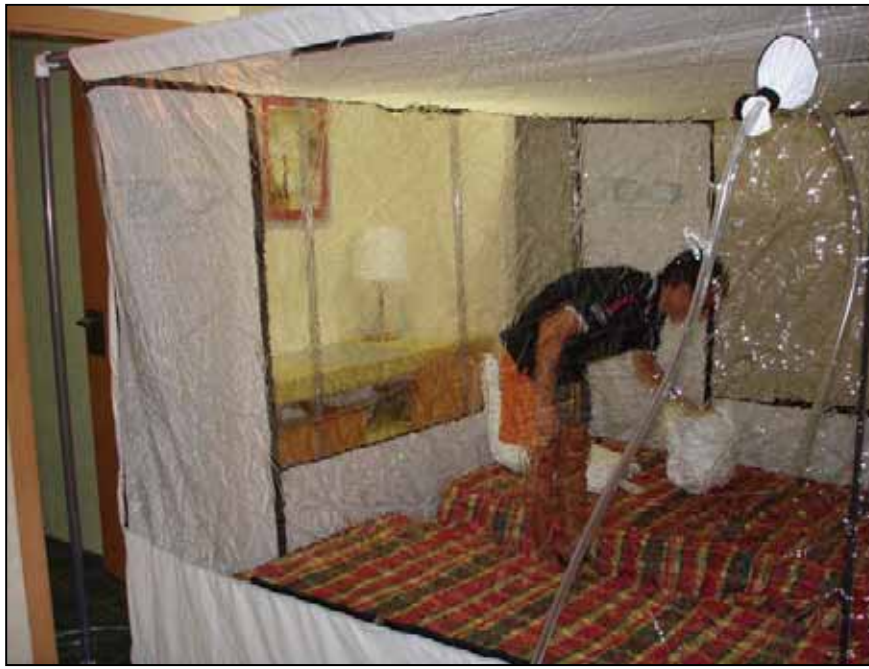
Natural Continuous Hypoxic Training (NCHT)

Normally 2000-3000 m permitting active training

Veleta Peak (3394 m)

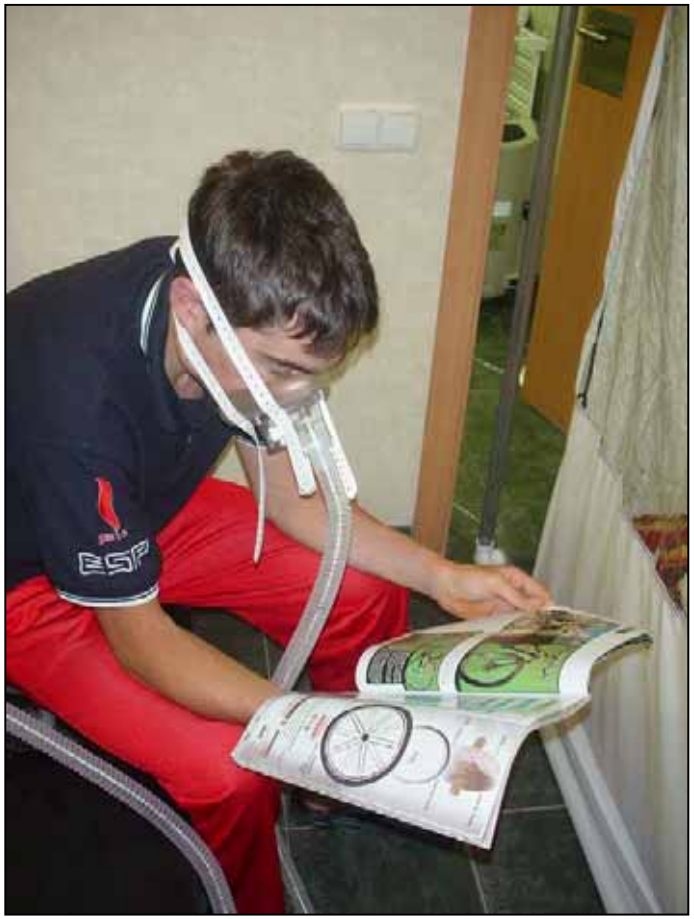
CAR Sierra Nevada (2320 m)

Artificial Continuous Hypoxic Training (ACHT)



CAR Sierra Nevada (2320 m) + <u>3500 m ACHT for SLEEPING</u>

Intermittent Hypoxic Training (IHT)



3000-6500 m

generally administered in passive manner

Protocol :

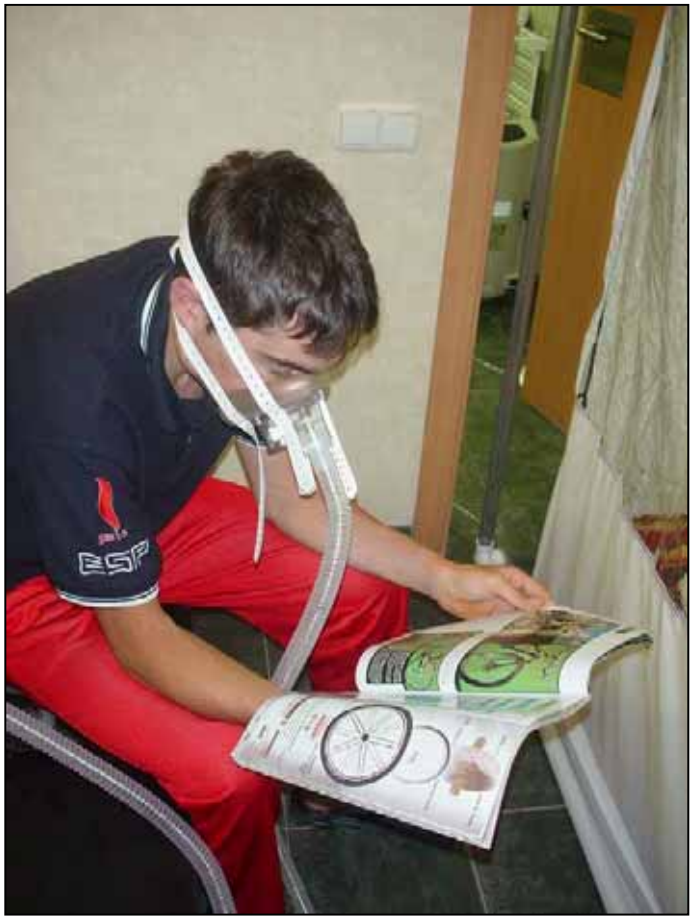
-60-90 min,

-6/10 intervals of 5 min hypoxia and 5 min rest,

-around 5 sessions/week

-during at list 7 subsequent days for acclimatisation (Foster et al., 2005) or at list 5-6 weeks for a gain in performance (Hamlin and Hellemans, 2007). Truijens et al. (2007) or Rodríguez et al. (2007) did not find improvements after 4 weeks

Intermittent Hypoxic Training (IHT)

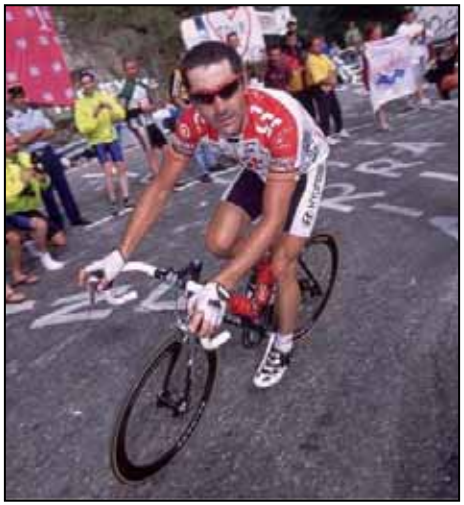


-Dufour et al. (2006) showed a significant improvement in aerobic performance capacity after 6 weeks of IHT combined twice a week with 2 sessions at VT2 during 24-40 min.

-IHT can be provided at rest to stimulate acclimatisation, or during exercise to enhance training stimulus (Levine, 2002).

-However, Koehle et al. (2007, 2008): there is no difference in the results obtained by 60 min of continuous IHT or by twelve 5 min bouts of IHT separated by 5 min bouts of room air.

IHT seems to benefit the acclimatization in the first days of moderate altitud



Responders and non-responders?

***Role of genetics** (Mason et al., 2007; Pisani and Dechesne, 2005)*

The oxygen sensitive subunit Alfa of Hypoxia Inducible Factor (HIF-1) complex is an essential protein for oxygen homeostasis system for cell energy production and survival, and the primary transcriptional response factor for acclimatisation to hypoxic stress

***The loss of HIF-1 alfa can result in altered exercise endurance** (Mason et al., 2007; Mason et al., 2004)*

***The variability among subjects is great** (Levine and Stray-Gundersen, 2006)*

BASIC ADVICES FOR COACHES

HT must be included in the training program as special stimulus and additional charge,

and has to be individualized and adapted to the context, progressively and always being very CAUTIOUS

Specific ergogenic aids should be used as well as training load indexes are controlled (RPE, Heart Rate variability, resting Heart Rate, sleeping pattern, and also haematological-biochemical information or pulseoximeter use if possible).

Ventilatory training should complement HT

(cheap and easy)

Start: 3x10 rep 3 days/w

Sildenafil (Viagra®) is suggested to protect against the development of altitude-induced pulmonary hypertension (Ricart et al. 2005):

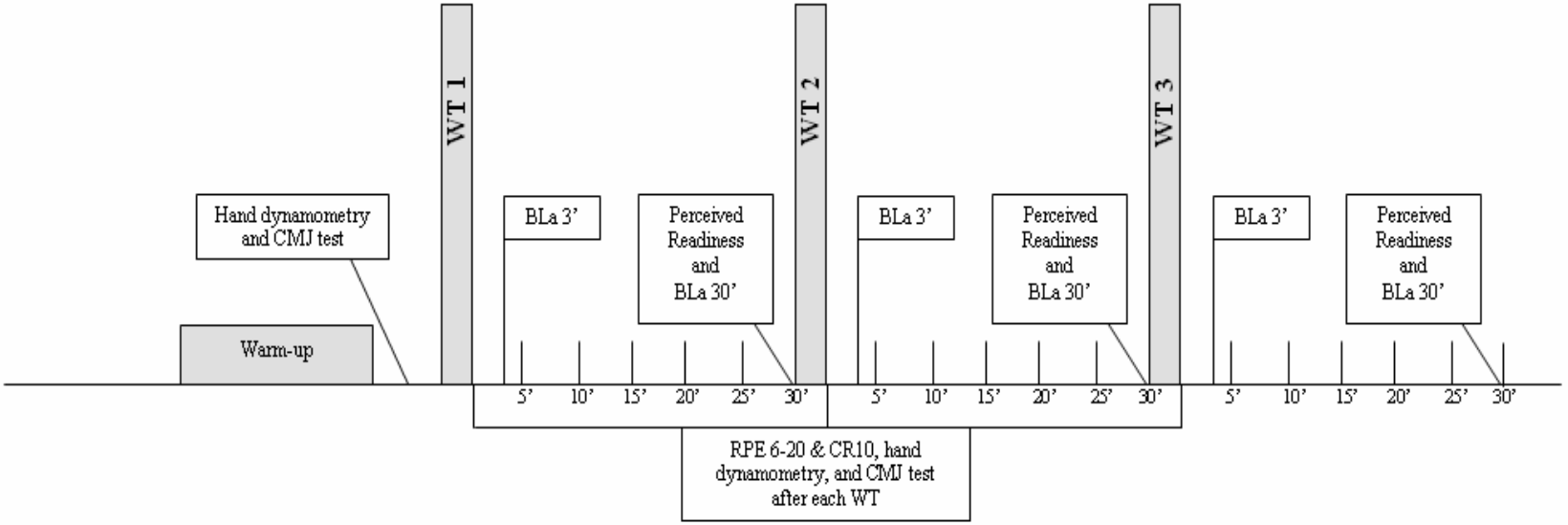
1) improving gas exchange, limiting the altitude-induced hypoxemia,
2) and decreasing in exercise performance (Faoro et al., 2007; Richalet et al., 2005)

Sildenafil can greatly improve cerebral oxygenation at altitude (Chan et al., 2005), cardiovascular function and performance in acute hypoxia but not in normoxia (Hsu et al., 2006)

Other used ergogenic aids:

HMB (beta-hydrosyl-beta-methylbutarate)
Malata citrulline (Stimol)
Creatine
Proteine
Iron, B12, Folic acid…

“Effects of sodium bicarbonate ingestion on performance and perceptual responses in a laboratory-simulated BMX cycling qualification series”



Zabala, M.; Requena; B.; Sánchez, C.; García, I., Glez.-Badillo, J.J.; Paasuke, M., Oopik, V. (in press)

Journal of Strength & Conditioning Research

A question for the scientists

Which is the real role of Lactate?????

Robergs RA, Ghiasvand F, Parker D. Biochemistry of exercise-induced metabolic acidosis. Am J Physiol Regul Integr Comp Physiol. 2004 Sep;287(3):R502-16.

Pedersen TH, Nielsen OB, Lamb GD, Stephenson DG. Intracellular acidosis enhances the excitability of working muscle. Science 2004; 305:1144–7.

Is it a buffer of acidosis instead the metabolite that causes it??
Is it an energy provision instead of a "poison"??

What helps to avoid overtraining in NCHT?

Field Testing (Pre-Pos)

What helps to avoid overtraining in NCHT?

Control of training and individual responses

Haemoglobin and Haematocrit

CK, Urea, Linfocites…

Use of powermeter, RHR, HRV, RPE, body composition, sleeping pattern…

What helps to avoid overtraining in NCHT?

Control of training and individual responses

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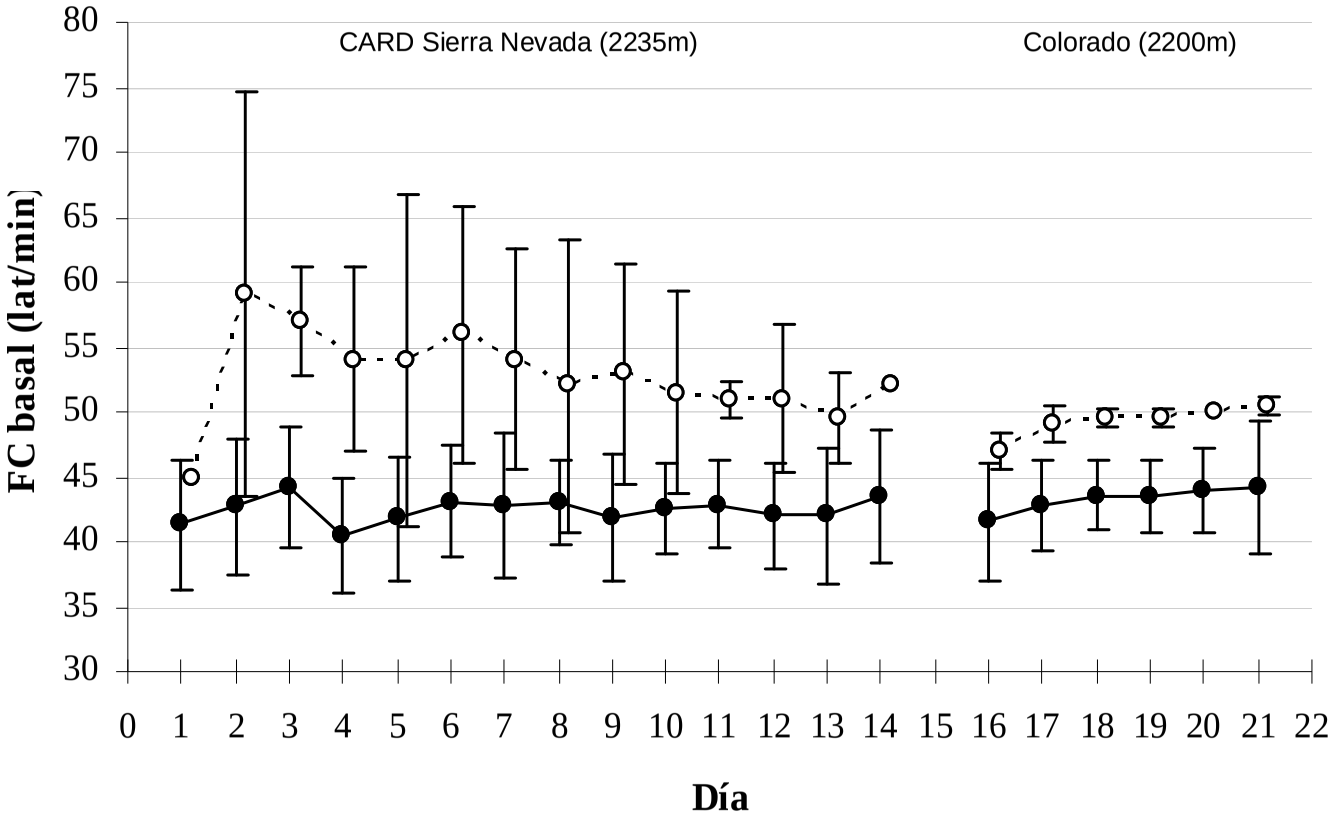
Control of training and individual responses



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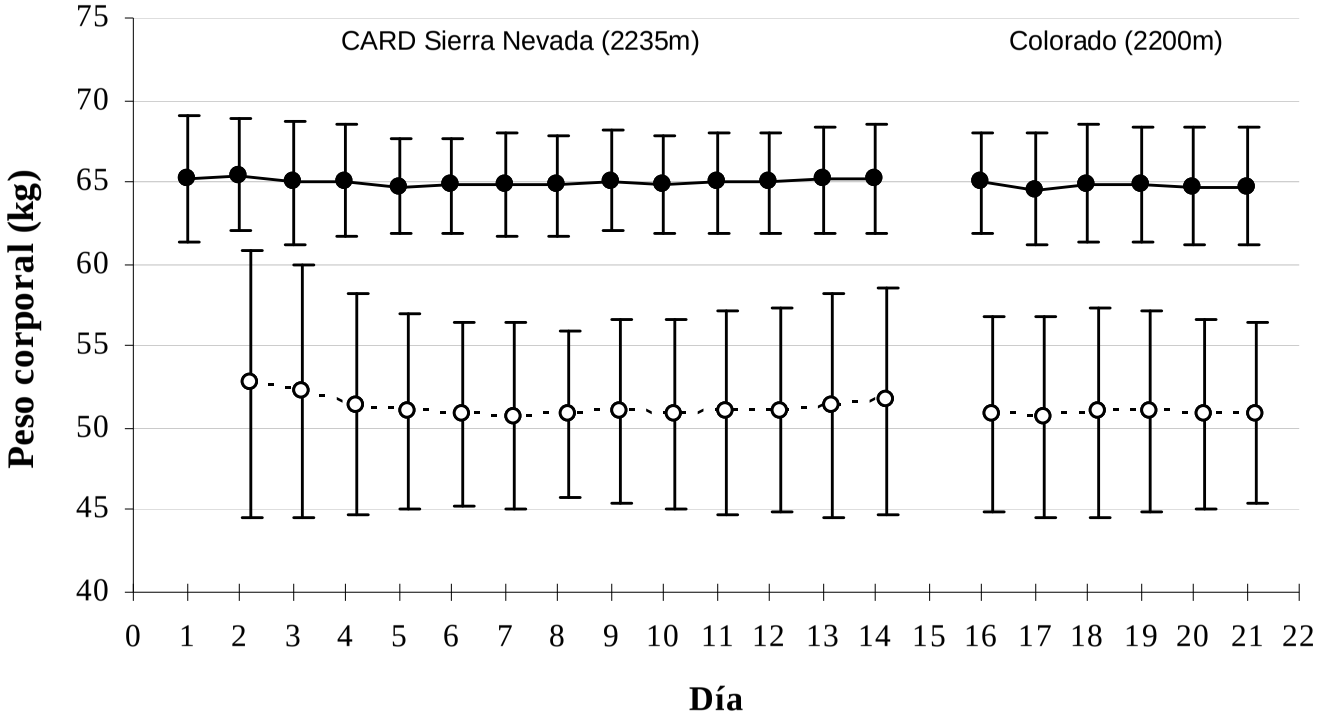

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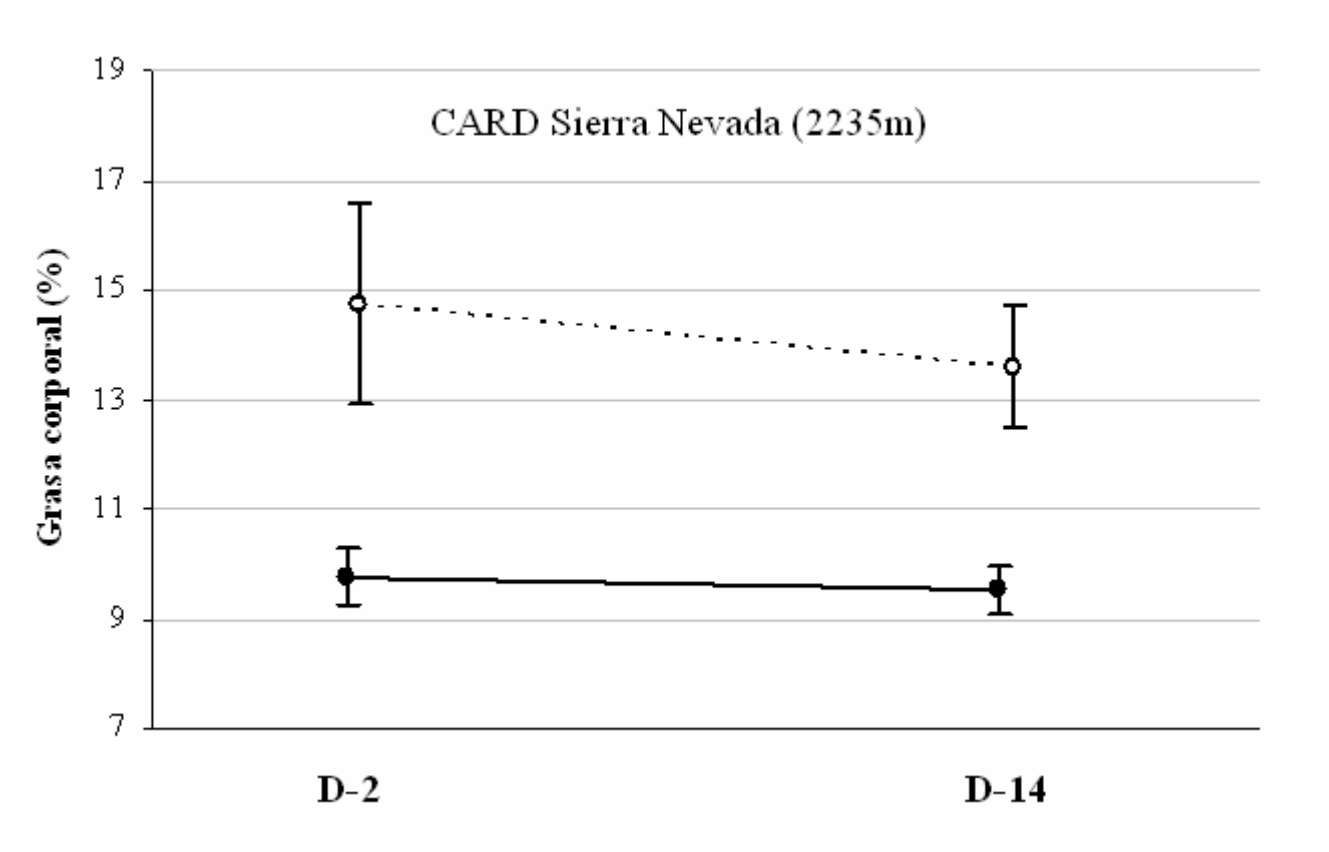

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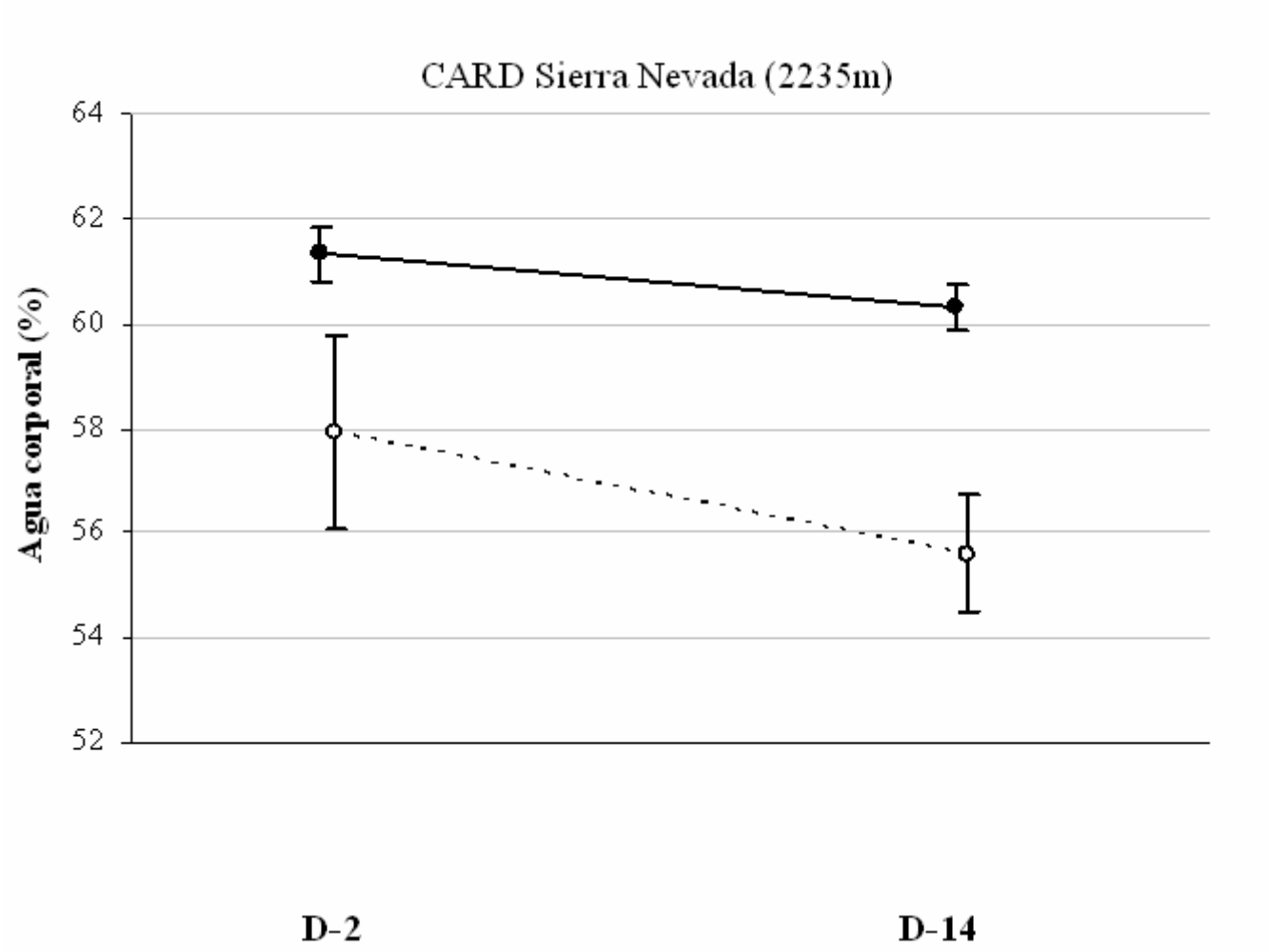

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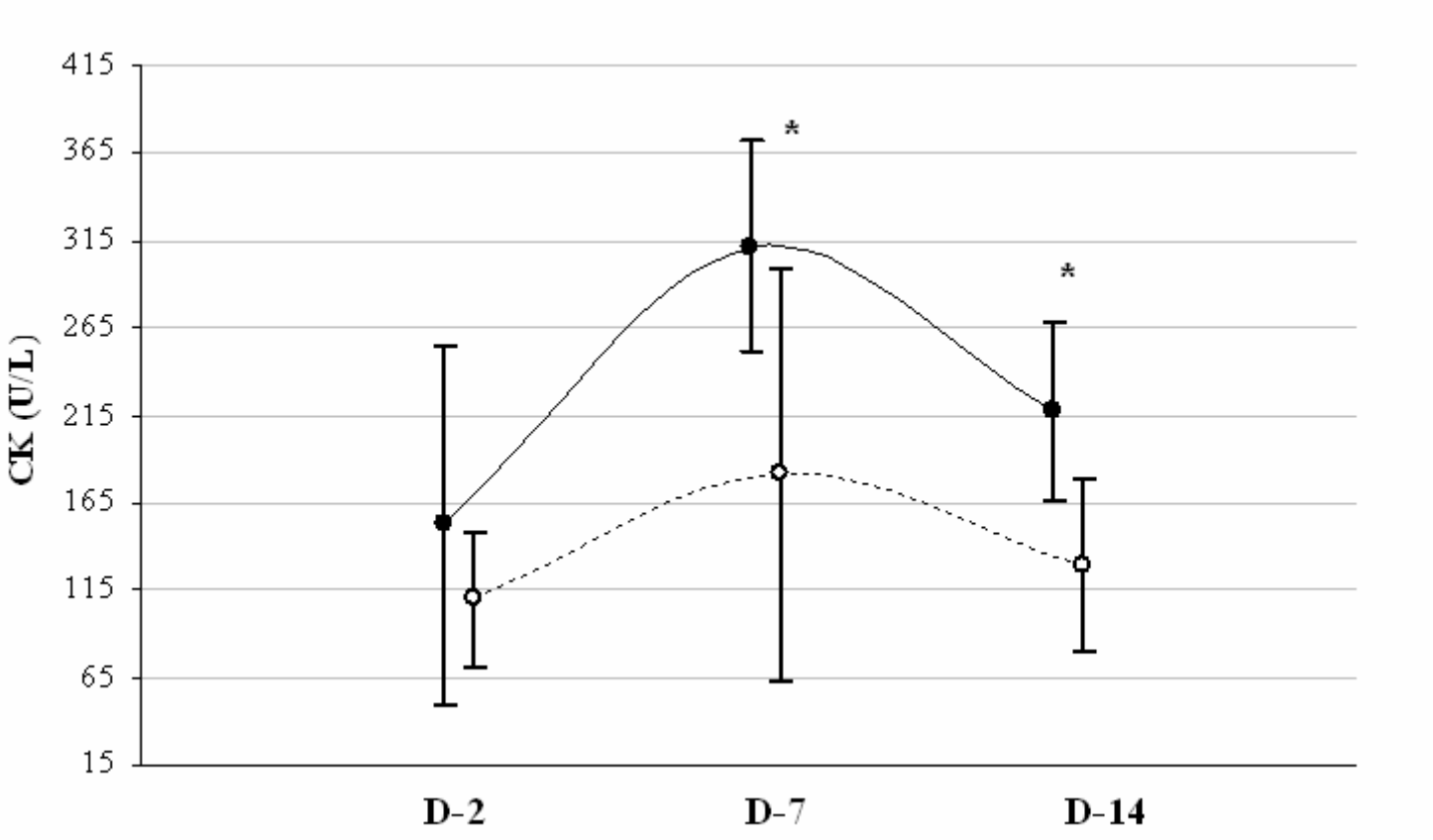
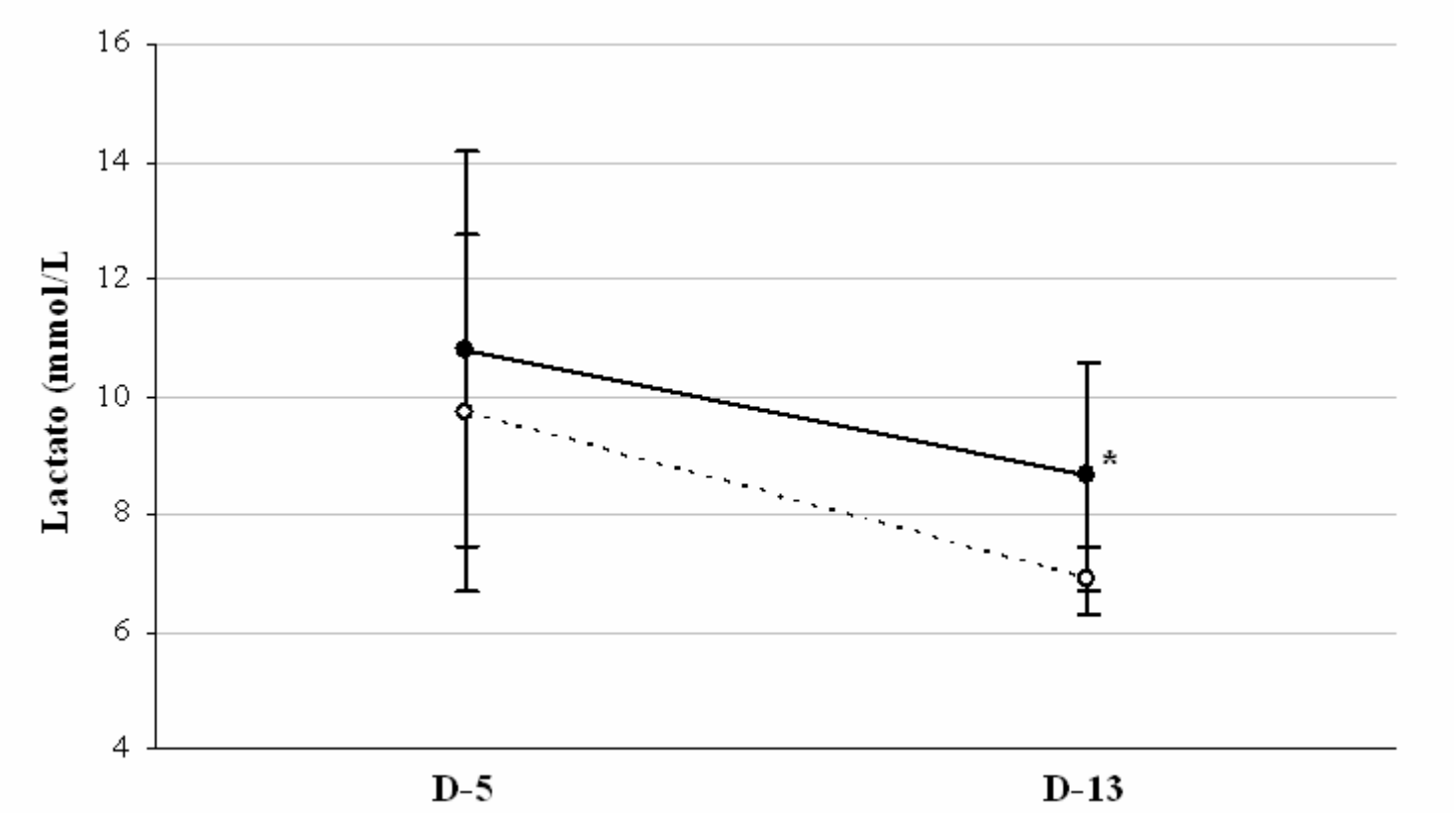


What helps to avoid overtraining in NCHT?

Control of training and individual responses



What helps to avoid overtraining in NCHT?

Helping recovery

What helps to avoid overtraining in NCHT?

PRACTICAL CASE: IÑAKI LEJARRETA

http://www.lejarreta-inaki.com/

2000: World Championships in Sierra Nevada (ESP)

1900 - 2100 m

Junior Vice-champion

&

Team Relay World Champion

LIVE LOW –

COMPETE HIGH

2001: World Championships in Colorado (USA)

2200 - 2500 m

Junior Champion

&

Team Relay

Bronce medal

LHTH & LHTL –

COMPETE HIGH

2004: World Championships in Les Gets (FRA)

1200 - 1700 m

4th place U23

&

3rd place in World Cup at Livigno (ITA) at 1800 m a week later

IHT +

2 WEEKS LHTH & LHTL

2005: World Championships in Livigno (ITA)

1800 m

IHT + 2 weeks Acclimatisation in Sierra Nevada

224 bpm exercising (laboratory test)

160 bpm when sleeping at night (HRM)

Hyperthyroidism detected after many tests

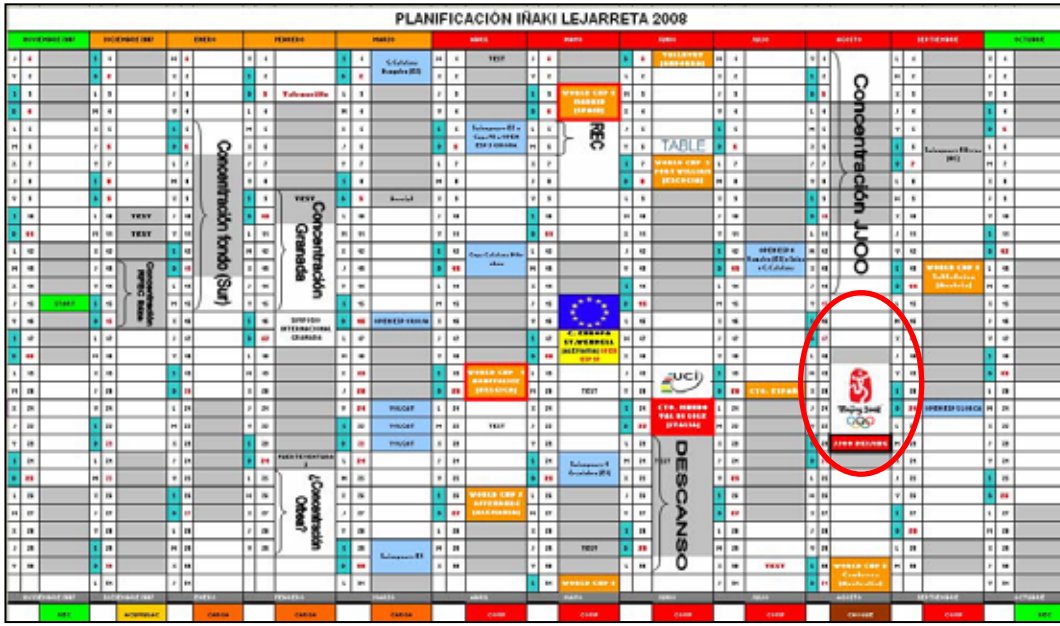
(Now controlling it specially…)

2006: recovery period, but competing

2007: World Championships in Fort William (UK)

2nd SPANISH RIDER OVERALL & QUALIFIED FOR THE OLYMPIC GAMES 2008

2008: OLYMPIC GAMES IN CHINA



CHT + IHT + STAYS IN ALTITUDE (SN)

Special control of T4

My daughter (2008)

Special Thanks to Dr. Ángel Gutiérrez

Always teaching…

Thank you very much!