Increased hair cortisol levels in female endurance athletes through altitude training: A useful diagnostic tool for overtraining

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Is hair cortisol levels useful for evaluating chronic stress in end Tr?
Method

7 female long-distance runners

O₂ Transport

Performance index
- VO₂max
- Red Cell Volume (RCV)
- Total Hemoglobin Mass (tHb)

Stress index
- Hair Cortisol
- Blood Cortisol
- Urine Cortisol

Sea-level Training

Altitude Training (1,800 m)

Sea-level Training

27 days

Pre-Hair Cortisol → Post-Hair Cortisol

Hair Cortisol Measurement

Sampling (1 cm) → 1 month

ELISA
Results

Performance

\[ \text{VO}_{2\text{max}} \] (ml/kg/min)

\[ * \]

Pre: 62 ± 2
Post: 64 ± 3

\[ p < 0.05 \]

RCV (ml)

Pre: 1500 ± 100
Post: 1400 ± 100

Stress (Cortisol level)

Hair (pg/mg)

Pre: 20 ± 5
Post: 22 ± 5

Pre: 100 ± 20
Post: 110 ± 20

Blood (μg/dl)

Pre: 10 ± 1
Post: 9 ± 1

Hair Cortisol

\[ \text{Δ} \text{VO}_{2\text{max}} \text{ (%)} \]

r = -0.773
n.s.

\[ \text{ΔRCV} \text{ (%)} \]

r = -0.726
p = 0.065

\[ \text{ΔtHb} \text{ (%)} \]

r = -0.756
p < 0.050

Post-Hair Cortisol levels (pg/mg)
Discussion

Higher hair cortisol levels were correlated with decreased Hb levels

Hair cortisol levels (pg/mg)

Hair cortisol levels may be useful for assessment of overtraining

Conclusion

Hair cortisol could be a potential biomarker of chronic stress at altitude training in endurance athletes