UNIVERSITÀ DEGLI STUDI DI VERONA

3rd Mountain, Sport & Health

UPDATING STUDY AND RESEARCH FROM LABORATORY TO FIELD

International congress 12-14 November 2009, Rovereto (TN) - Italy

Biochemical adaptations in endurance atletes: "from the field to the benchside"

Gian Luca Salvagno MD, Giuseppe Lippi MD

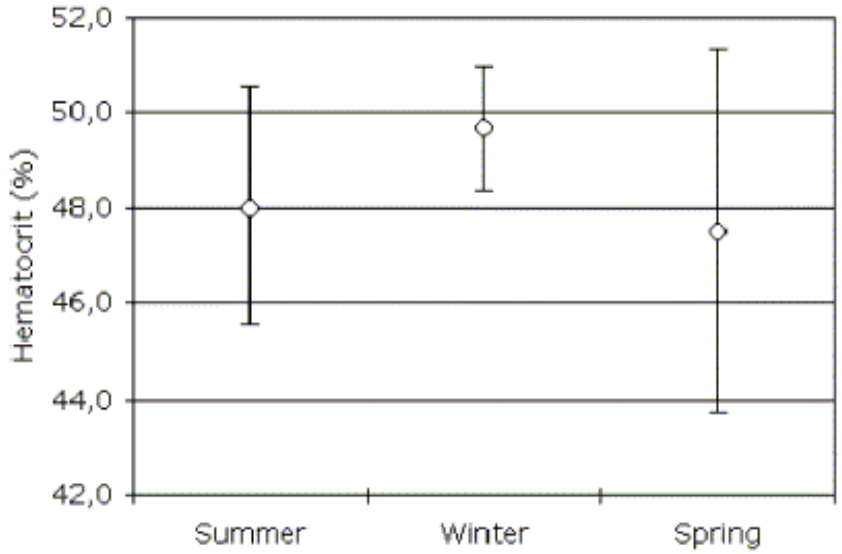
Clin. Lab. Haem. 2002, **24**, 1–2

Hematocrit measurement and antidoping policies

G. LIPPI*, **M. FRANCHINI†**, **G. GUIDI***

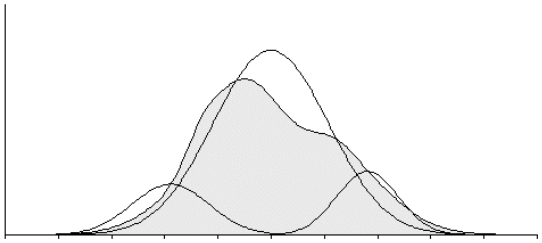
**Istituto di Chimica e Microscopia Clinica, Dipartimento di Scienze Morfologiche e Biomediche† Università degli Studi di Verona, Verona, Italy, and †Servizio di Immunoematologia e Trasfusione Ospedale Policlinico, Azienda Ospedaliera di Verona, Verona, Italy.*

2002

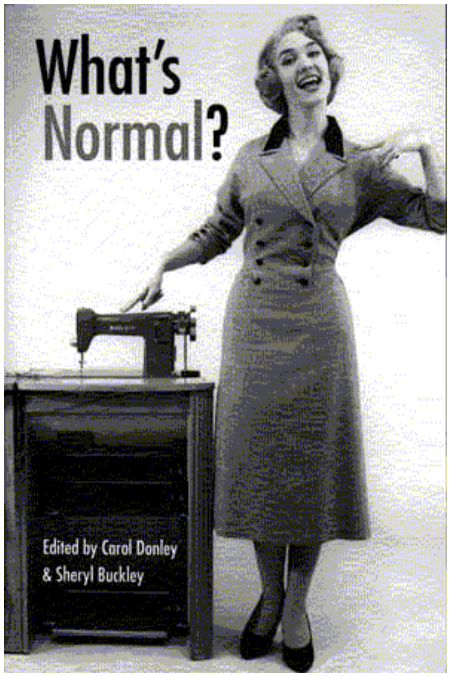


Our observation further emphasizes the inappropriateness and unsuitability of Hct measurement for detection of blood doping or misuse of rHuEpo in athletes.

To confirm this hypothesis, Hct values of six professional and two elite male cyclists were measured during routine haematological testing, from summer 2000 to spring 2001.



Athletes: Normal people?



Definition of Normal

Nor´mal Pronunciation: nôr´mal

a. 1.

1. According to an established norm, rule, or principle; conformed to a type, standard, or regular form; performing the proper functions; not abnormal; regular; natural; analogical.

Deviations from the **normal** *type.*

- Hallam

Definition of Abnormal

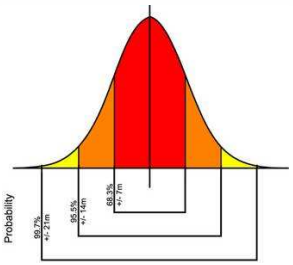
Ab`nor´mal

a. 1. Not conformed to rule or system; deviating from the type; anomalous; irregular.

Managing transferability of laboratory data

Gian Cesare Guidi [a,c,*], Giuseppe Lippi [a,c], Giovanni Pietro Solero [a], Giovanni Poli [a], Mario Plebani [b,d]

Clinica Chimica Acta 374 (2006) 57–62

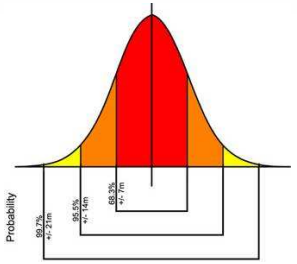


- **Results of laboratory test are commonly interpreted by comparison with predetermined intervals of reference**
- **The concept of IR was introduced in 1969 by Gräsbeck and Saris, with the aim to replace the former fuzzy definition of "normal value"**
- **The term proved successful everywhere, not only in diagnostic and laboratory settings, but especially when relevant biological and medical observations have to be explaind and/or interpreted. When constructing an IR from individual data, one can perceive the difficulty to achieve a perfect Gaussian distribution.**

Managing transferability of laboratory data

Gian Cesare Guidi [a,c,*], Giuseppe Lippi [a,c], Giovanni Pietro Solero [a], Giovanni Poli [a], Mario Plebani [b,d]

Clinica Chimica Acta 374 (2006) 57–62

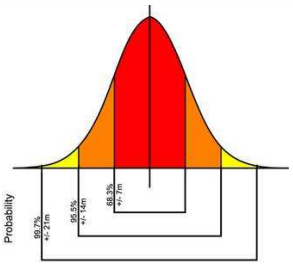


- **A diffused but unsupported notion is that the IR obtained from either Gaussian or non-Gaussian distributions represents the values of individuals to be referred to ("the normals", for example) and that the residual low and high curve areas or percentiles represent individuals showing values to be discarded ("the outnormals").**
- **This is a conceptual mistake, as**
  - **(a) even the latter individuals were initially recruited as part of a group with a series of characteristics set before extracting the reference interval,**
  - **(b) all the values either far from or around the limits are only punctual representation of the biological variation**
  - **(c) the analytical variability influences anyhow the actual data.**

Managing transferability of laboratory data

Gian Cesare Guidi [a,c,*], Giuseppe Lippi [a,c], Giovanni Pietro Solero [a], Giovanni Poli [a], Mario Plebani [b,d]

Clinica Chimica Acta 374 (2006) 57–62



- **Cross-sectional comparison of laboratory results**
  - **range of values opportunely obtained from individuals matched for gender and age.**
- **Longitudinal comparison of laboratory results**
  - **The concept of Reference Change (RC) was proposed by Harris and Yasaka, to evaluate the significance of the change between two successive measurements.**
  - **The longitudinal comparison is based on this concept and it is principally justified by some clinical considerations that would be incompletely satisfied by the cross-sectional comparison**

Clinical Chemistry 47, No. 12, 2001

Reference Change Value Concept Combining Two Delta Values to Predict Crises in Renal Posttransplantation, *Carmen Biosca,[1*] Carmen Ricós,[2] Ricardo Lauzurica,[1] Román Galindo,[1] and Per Hyltoft Petersen[3]*

Longitudinal comparison

Reference Change Value

$$RCV = 2 \cdot \sqrt{z} \cdot \sqrt{(CV_i^2 + CV_a^2)}$$

CV_i :within-subject biological variation

CV_a: analytical variation of the test.

N.B.: $CV_a < ½CV_i$

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Clin Chem Lab Med 2004;xx(x):xxx-xxx © 2004 by Walter de Gruyter • Berlin • New York

Comparison of serum creatinine, uric acid, albumin and glucose in male professional endurance athletes compared with healthy controls

Giuseppe Lippi[1,*], Giorgio Brocco[1], Massimo Franchini[3], Federico Schena[2] and Giancesare Guidi[1]

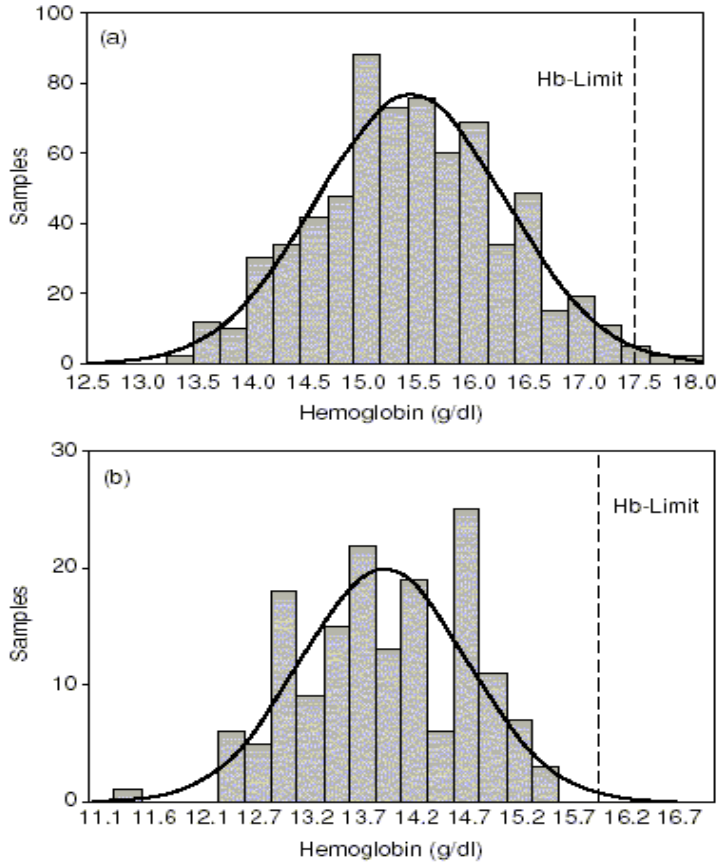
Owing to considerable physical, endocrinological and metabolic adaptations, the analysis of biochemical data in elite and top-class athletes requires caution.

Taken together, biochemical measurements in endurance-trained professional athletes at rest demonstrate that values lying outside the conventional reference ranges might reflect normal adaptations to regular and demanding physical exercise instead of underlying pathologies.

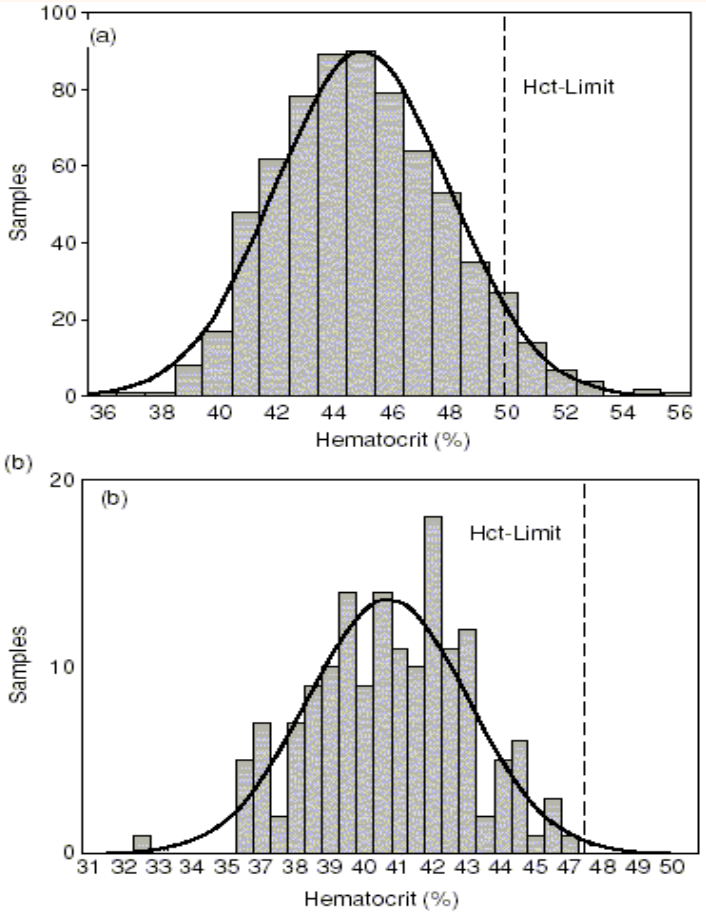
2004/402

Comparison of serum creatinine, uric acid, albumin and glucose in male professional endurance athletes compared with healthy controls

Giuseppe Lippi[1,*], Giorgio Brocco[1], Massimo Franchini[3], Federico Schena[2] and Giancesare Guidi[1]



Distribution of Hb in 1323 blood samples of 169 male (a) and 302 blood samples of 55 female (b) cyclists of the German national team.



Distribution of Hct in 1323 blood samples of 169 male (a) and 302 blood samples of 55 female (b) cyclists of the German national team.

Scand J Med Sci Sports 2002: 12: 301–308

Hematological indices in elite cyclists

Y. O Schumacher, R Jankovits, D Bültermann, A Schmid, A Berg

Intervals of Reference (IR) 1

	Sedentari	Dilettanti	Ciclisti	Sciatori
n.	66	80	78	38
WBC x $10^3/\mu L$	$6,5 \pm 1,7$	$5,9 \pm 1,1^{\dagger}$	$6,1 \pm 1,4^{\dagger}$	$5,9 \pm 1,1^{\dagger}$
Plt x $10^3/\mu L$	248 ± 53	$229 \pm 37^{\dagger}$	$233 \pm 44^{\dagger}$	261 ± 52
Ret x $10^9/L$	60 ± 26	47 ± 20	60 ± 25	$89 \pm 20^{\ddagger}$
Ret (%)	$1,1 \pm 0,5$	$1,0 \pm 0,4$	$1,2 \pm 0,5$	$1,5 \pm 0,1^{\ddagger}$
CHr (pg)	$32,8 \pm 1,6$	$32,6 \pm 1,7$	$33,4 \pm 1,3^{\dagger}$	$32,8 \pm 1,0$

† $p < 0.05$; ‡ $p < 0.01$

Intervals of Reference (IR) 2

	Disciplina sportiva		Carico di lavoro	
	Ciclisti	Sciatori	Dilettanti	Prof.
n.	78	38	80	78
RBC x $10^6/\mu L$	5,0 ± 0,4	5,4 ± 0,3‡	5,0 ± 0,3	5,0 ± 0,4
Ht (%)	45,6 ± 2,9	48,1 ± 2,5‡	46,1 ± 2,4	45,6 ± 2,9
Hb (g/dL)	15,1 ± 0,9	15,6 ± 1,9†	15,1 ± 0,8	15,1 ± 0,9
MCV (fL)	92 ± 4	89 ± 3†	93 ± 4	92 ± 4
MCH (pg)	30,6 ± 1,6	29,5 ± 0,9†	30,5 ± 1,3	30,6 ± 1,6
% Macro	1.6 ± 1.6	0.5 ± 0.4‡	2.1 ± 2.1	1.6 ± 1.6

† $p < 0.05$; ‡ $p < 0.01$

Biological Variability and Reference Change Value

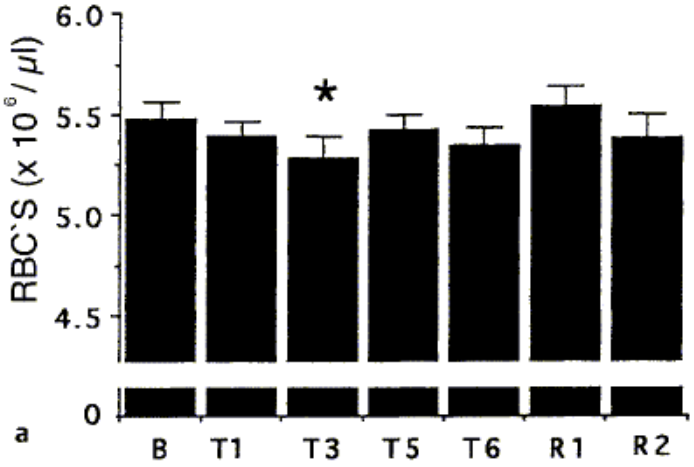
n. 28	07/01 → 03/03	CVbi	CVa	RCV
RBC	0,2%	1,8%	2,0%	4,8%
Ht	3,5%	2,3%	2,0%	6,8%
Hb	0,8%	2,3%	1,5%	4,5%
WBC	11,3%	9,2%	2,5%	14,3%
Plt	-5,8%	4,8%	5,0%	10,4%
Reticulocytes	16,3%	20,3%	-	-
%Macro	38,0%	51,5%	-	-
CHr	0,1%	1,8%	-	-

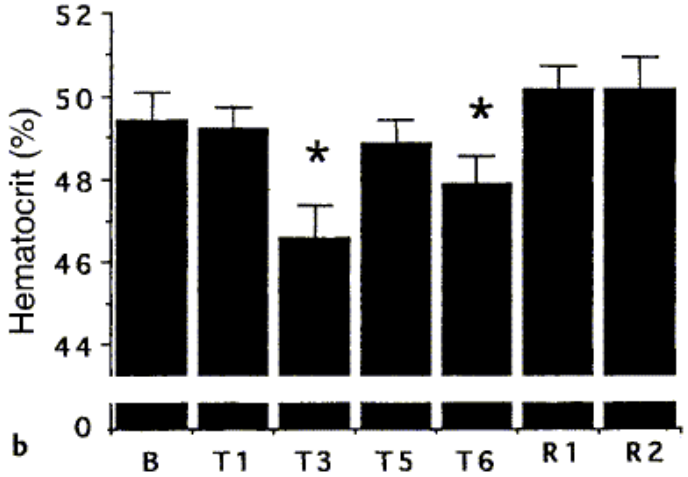
Iron Status in Cyclists During High-Intensity Interval Training and Recovery

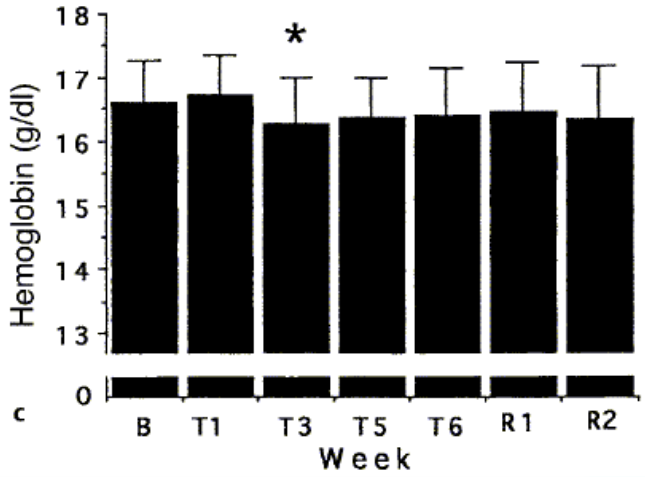
J. G. Wilkinson[1]
D. T. Martin[3]
A. A. Adams[1]
M. Liebman[2]

Int J Sports Med 2002; 23: 544–548

The effects of high-intensity training and recovery on red blood cell count (**a**), hematocrit (**b**) and hemoglobin (**c**) (B = baseline, T = training, and R = recovery weeks). *significantly different from baseline.







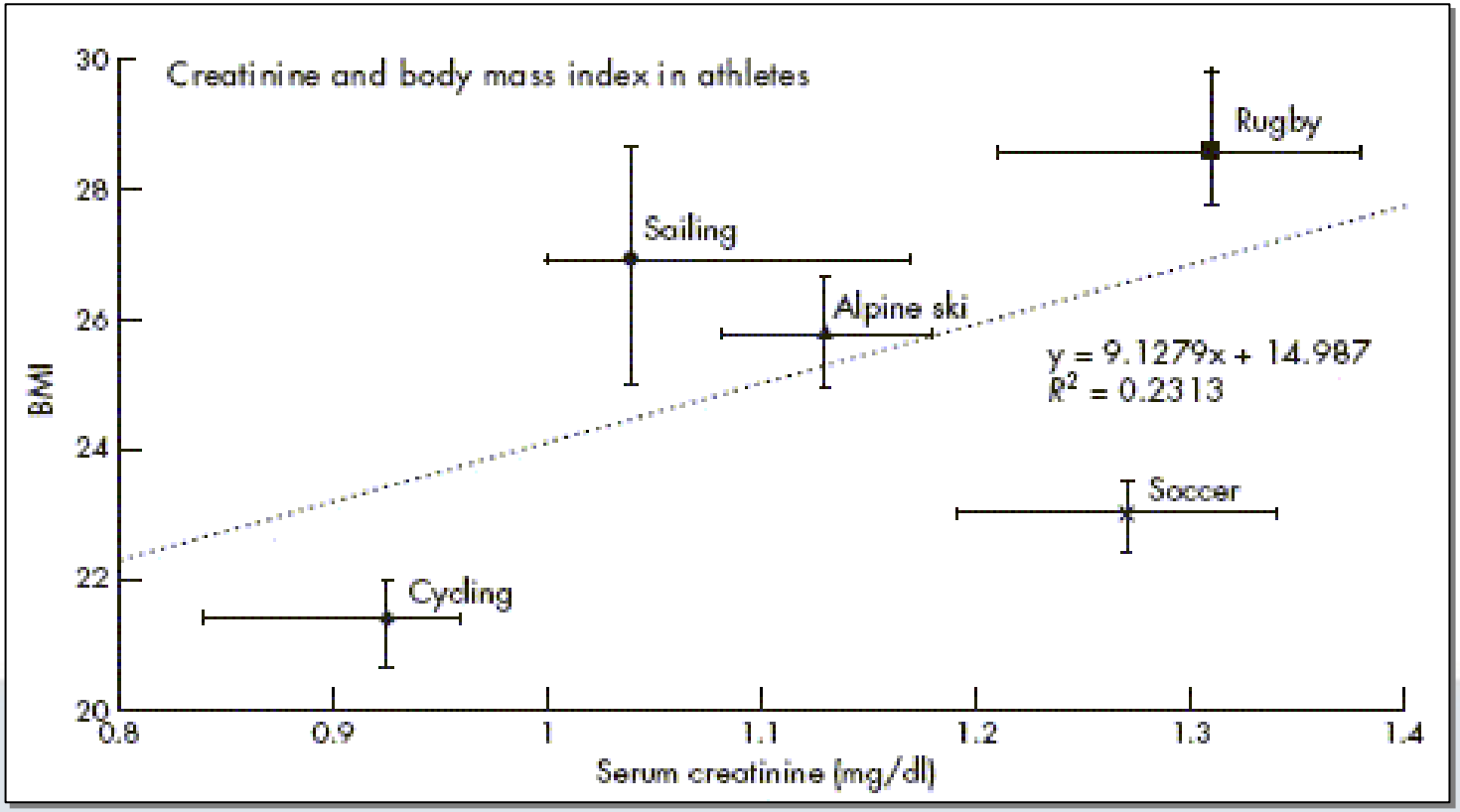
ORIGINAL ARTICLE ..... COMMENTARY .....

Relation between serum creatinine and body mass index in elite athletes of different sport disciplines

G Banfi, M Del Fabbro

G Lippi

Br J Sports Med 2006;40:675–678. doi: 10.1136/bjsm.2006.026658



Clin Chem Lab Med 2008;46(2):235–239 © 2008 by Walter de Gruyter • Berlin • New York. DOI 10.1515/CCLM.2008.039

Comparison of creatinine-based estimations of glomerular filtration rate in endurance athletes at rest

Giuseppe Lippi[1,*], Giuseppe Banfi[2], Gian Luca Salvagno[1], Martina Montagnana[1], Massimo Franchini[3] and Gian Cesare Guidi[1]

Table 1 Main demographic data and values of serum creatinine and glomerular filtration rate (GFR), calculated according to the Cockcroft-Gault (C-G), Modification of Diet in Renal Disease (MDRD) and Mayo Clinic Quadratic Equation (MCQE) formulas, in 60 professional male cyclists and 60 healthy matched sedentary controls.

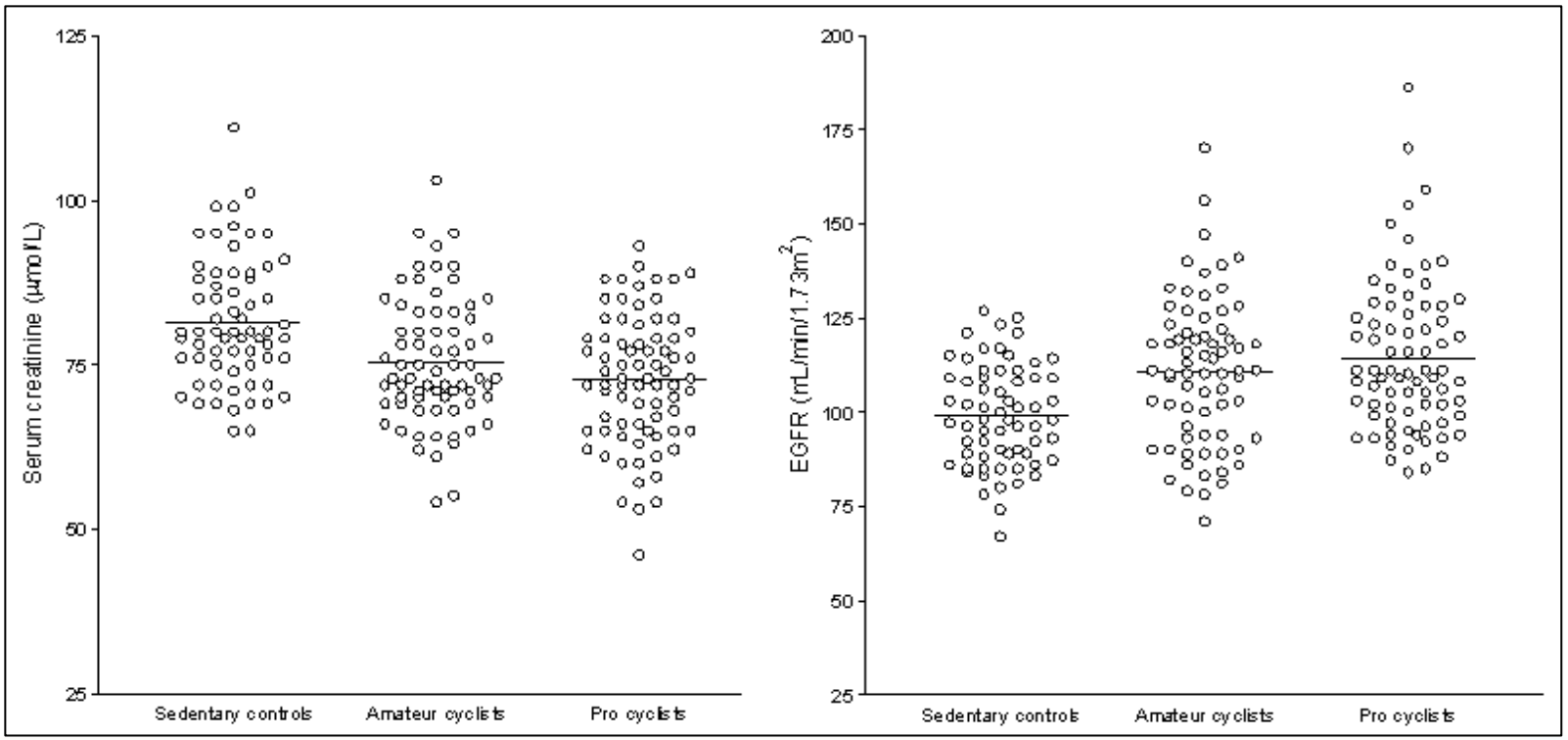
	Sedentary controls	Professional cyclists	p-Value
n	60	60	
Age, years	28 (19–39)	27 (21–35)	0.062
Body weight, kg	75 (57–96)	67 (56–80)	<0.001
Height, cm	179 (165–190)	177 (166–189)	0.093
Body mass index, kg/m^2	24 (20–29)	21 (19–24)	<0.001
Training, h/day	0.1 (0.0–0.2)	2.8 (1.8–3.7)	<0.001
Creatinine, μmol/L	81 (69–99)	73 (56–90)	<0.001
C-G, mL/min	127 (98–182)	127 (95–168)	0.490
MDRD, mL/min/1.73 m^2	104 (86–127)	119 (90–167)	<0.001
MCQE, mL/min/1.73 m^2	135 (116–153)	137 (112–149)	0.128

Values are given as mean and 95% confidence interval.

Clin J Sport Med • Volume 18, Number 3, May 2008

Glomerular Filtration Rate in Endurance Athletes

Giuseppe Lippi, MD, Giuseppe Banfi, MD,† Gian Luca Salvagno, MD,**
*Massimo Franchini, MD,‡ and Gian Cesare Guidi, MD**



Values distribution of serum creatinine and estimated glomerular filtration rate, calculated according to the Modification of Diet in Renal Disease (MDRD) formula, in 76 professional (pro) male road cyclists, 71 amateur male road cyclists and 65 healthy matched sedentary controls. The central horizontal bars indicate the mean value.

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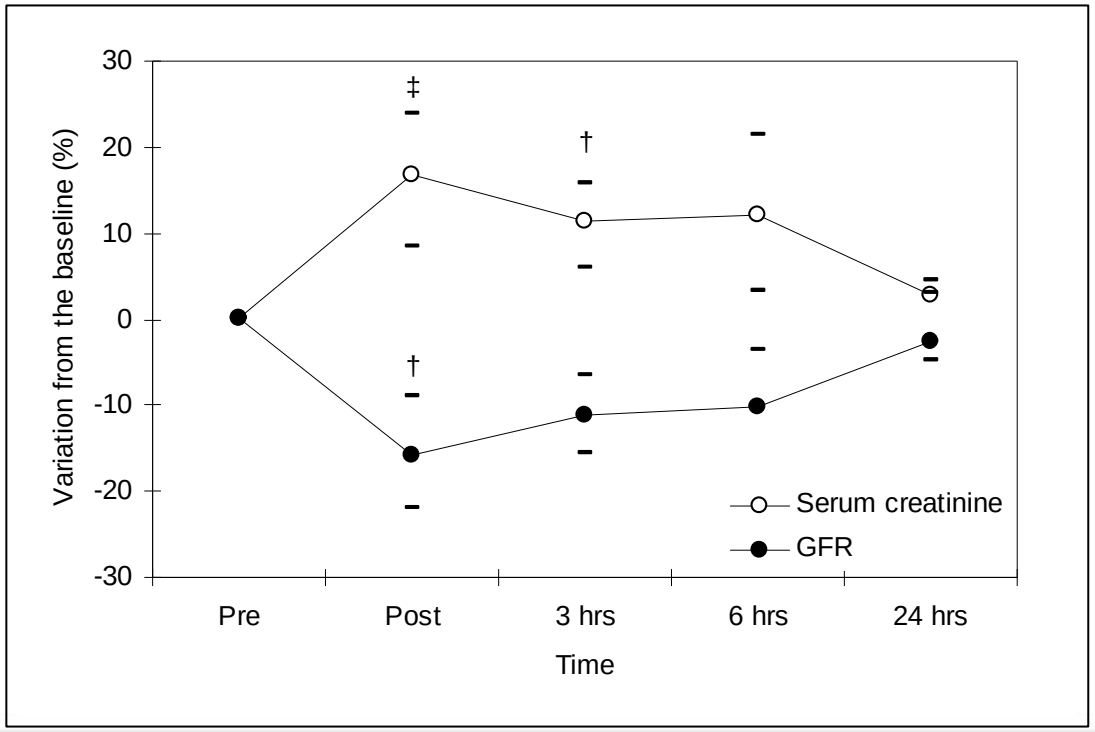
Acute Variation of Estimated Glomerular Filtration Rate Following a Half-Marathon Run

Physiology & Biochemistry

G. Lippi[1], F. Schena[2], G. L. Salvagno[1], C. Tarperi[2], M. Montagnana[1], M. Gelati[1], G. Banfi[3], G. C. Guidi[1]



Percentage variation of serum creatine and estimated glomerular filtration rate (EGFR) values before (pre), immediately after (post), 3 (3 hrs), 6 (6 hrs) and 24 (24 hrs) hours after a 21-km half-marathon in 17 healthy trained males. Values are shown as geometric mean and 95% confidence of interval. † p <0.05 and ‡ p <0.01 versus the pre-run sample.

Chronic influence of demanding physical exercise on venous blood-gas status

Giuseppe Lippi[a,*], Federico Schena[b], Massimo Franchini[c], Gian Cesare Guidi[a]

Journal of Science and Medicine in Sport (2007) 10, 288–290

Journal of Science and Medicine in Sport

Table 1 Venous blood-gas status in sedentary individuals, elite and professional road cyclists

	Sedentary controls	Elite athletes	Professional athletes
n	58	72	47
pH	7.35 ± 0.03	7.34 ± 0.03	7.35 ± 0.03
PvO_2 (mmHg)	30 ± 11	30 ± 7	31 ± 9
$PvCO_2$ (mmHg)	51 ± 5	54 ± 4	52 ± 5
Saturation (%)	53 ± 19	54 ± 16	54 ± 16
p50 (mmHg)	25 ± 1	26 ± 1†	27 ± 0.8†

Data are presented as mean and standard deviation.

† $p < 0.01$ vs. sedentary controls. PvO_2, venous oxygen tension; $PvCO_2$, venous carbon dioxide tension.

Chronic influence of demanding physical exercise on venous blood-gas status

Giuseppe Lippi[a,*], Federico Schena[b], Massimo Franchini[c], Gian Cesare Guidi[a]

Journal of Science and Medicine in Sport (2007) 10, 288–290

Journal of Science and Medicine in Sport

- In elite and professional athletes at rest, moderate to high physical workloads may be well-tolerated, producing favourable adaptations on the aerobic oxygen metabolism.

- The chronic improvement of the oxygen metabolism in endurance athletes may be associated with an improved muscular recovery following exercise.

Clin Chem Lab Med 2008;46(9):1313–1318 © 2008 by Walter de Gruyter • Berlin • New York. DOI 10.1515/CCLM.2008.250

Influence of acute physical exercise on emerging muscular biomarkers

Giuseppe Lippi[1,*], Federico Schena[2], Martina Montagnana[1], Gian Luca Salvagno[1] and Gian Cesare Guidi[1]

Clin Chem Lab Med 2008;46:1313–8.

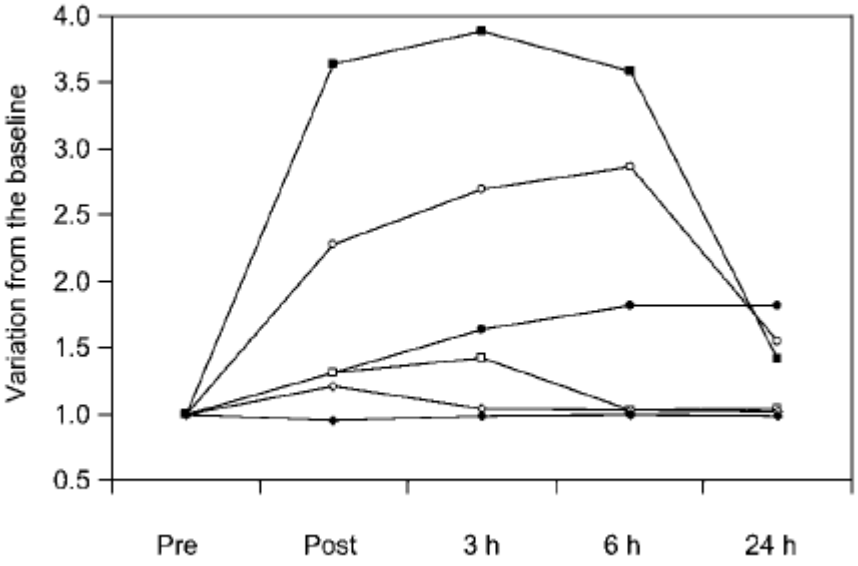


Figure 1 Variation of biochemical markers of muscle damage (□=glycogen phosphorylase isoenzyme BB, GPBB; ●=creatine kinase isoenzyme MB, CK-MB; ○=carbonic anhydrase III, CAIII; ■=myoglobin; ♦=ischemia modified albumin, IMA; ◇=heart-type fatty acid-binding protein, H-FABP) following a half-marathon run in 10 recreational male athletes.

Clin Chem Lab Med 2008;46(9):1313–1318 © 2008 by Walter de Gruyter • Berlin • New York. DOI 10.1515/CCLM.2008.250

Influence of acute physical exercise on emerging muscular biomarkers

Giuseppe Lippi[1,*], Federico Schena[2], Martina Montagnana[1], Gian Luca Salvagno[1] and Gian Cesare Guidi[1]

Clin Chem Lab Med 2008;46:1313–8.

Table 1 Variation of biochemical markers of muscle damage before (pre), immediately after (post), 3, 6 and 24 h after a 21-km half-marathon run in 10 recreational male athletes.

	Pre	Post	3 h	6 h	24 h
Plasma volume change, %		−7.6±0.9**	−1.0±1.4	+0.9±1.7	+3.2±0.9*
Weight loss, %		7.8±0.7**	1.2±0.8	−0.5±0.8	−2.5±0.7*
CAIII, μg/L	14±2	31±5**	37±8**	40±7**	21±2**
CK-MB, μg/L	1.5±0.2	1.9±0.2**	2.4±0.2**	2.6±0.2**	2.6±0.2**
cTnI, μg/L	<0.18	<0.18	<0.18	<0.18	<0.18
H-FABP, μg/L	4.1±0.1	4.9±0.1**	4.2±0.1	4.2±0.1	4.1±0.1
GPBB, μg/L	2.1±0.1	2.8±0.3*	3.0±0.3**	2.2±0.1	2.2±0.1
IMA, kU/L	92±1	87±3	91±2	91±2	91±2
Myoglobin, μg/L	18±3	67±8**	72±13**	66±7**	26±3*

Values are presented as geometric mean±standard error of the mean (SEM). Differences from the pre-marathon values were evaluated by the Mann-Whitney U-test. CAIII, carbonic anhydrase III; CK-MB, creatine kinase isoenzyme MB; cTnI, cardiac troponin I; H-FABP, heart-type fatty acid-binding protein; GPBB, glycogen phosphorylase isoenzyme BB; IMA, ischemia modified albumin. *$p<0.05$ and **$p<0.01$ (vs. the pre-run sample).

Clin Chem Lab Med 2008;46(2):247–249 © 2008 by Walter de Gruyter • Berlin • New York. DOI 10.1515/CCLM.2008.024

N-Terminal proB-type natriuretic peptide (NT-proBNP) concentrations in elite rugby players at rest and after active and passive recovery following strenuous training sessions

Giuseppe Banfi[1,2,*], Gianlodovico Melzi D'Eril[2,3], Alessandra Barassi[2,3] and Giuseppe Lippi[4]

Table 1 Median (and 95% confidence interval) NT-proBNP levels (pg/mL) in rugby players before and after training and recovery.

Type of recovery	Before training	After training	After recovery	p-Value, F-ratio
Passive (rest)	27.1 (17.8–41.3)	47.7 (28.7–71.8)	48.8 (30.6–75.0)	<0.01, 5.1
Cold water immersion followed by active recovery	30.2 (14.1–46.8)	57.4 (28.8–95.2)	64.3 (26.8–85.1)	<0.001, 10.9
Active recovery followed by cold water immersion	38.6 (18.6–75.9)	78.1 (35.3–150.0)	88.6 (33.7–144.0)	<0.05, 5.1

SHORT COMMUNICATION

Influence of a Half-Marathon Run on NT-proBNP and Troponin T.

GIUSEPPE LIPPI[1], FEDERICO SCHENA[2], GIAN LUCA SALVAGNO[1], MARTINA MONTAGNANA[1], MATTEO GELATI[1], CANTOR TARPERI[2], GIUSEPPE BANFI[3], GIAN CESARE GUIDI[1]. Clin. Lab. 2008;54

Table 1: Variation of plasma volume, troponin T (TnT) and N-terminal proB-type natriuretic peptide (NT-proBNP) values before (pre), immediately after (post), 3, 6 and 24 h after a 21-km half-marathon run in 17 healthy, trained males. Values are presented as geometric mean ± the standard error of the mean. Differences from the pre-marathon values are evaluated by Mann-Whitney U test.

	Pre	Post	3 h	6 h	24 h
Plasma volume change (%)	-	6.8±1.1‡	1.8±1.0	-1.0±3.1	-4.4±1.0‡
NT-proBNP (pg/mL)	28.8±4.8	56.6±9.2‡	50.2±8.1‡	50.0±6.7‡	41.9±6.5†
TnT (ng/mL)	<0.03	<0.03	<0.03	<0.03	<0.03

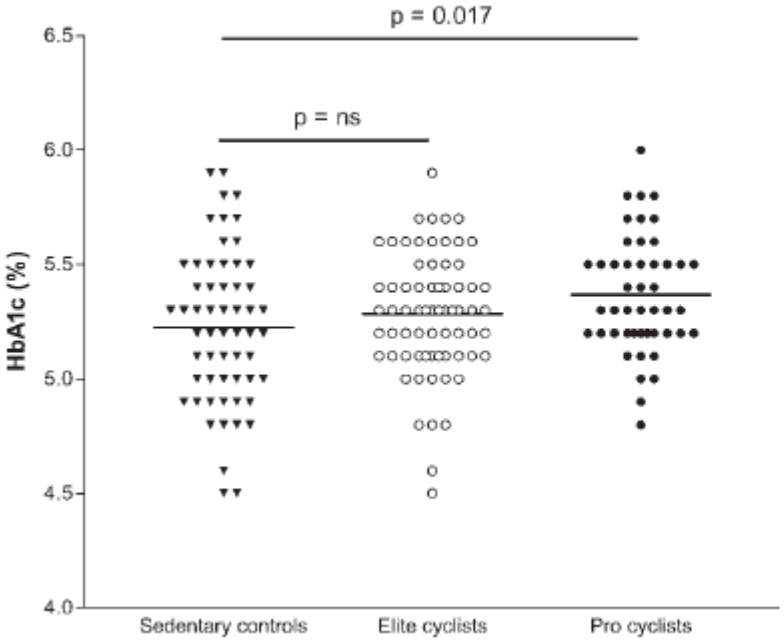
† $p < 0.05$ and ‡ $p < 0.01$ (versus the pre-run sample).

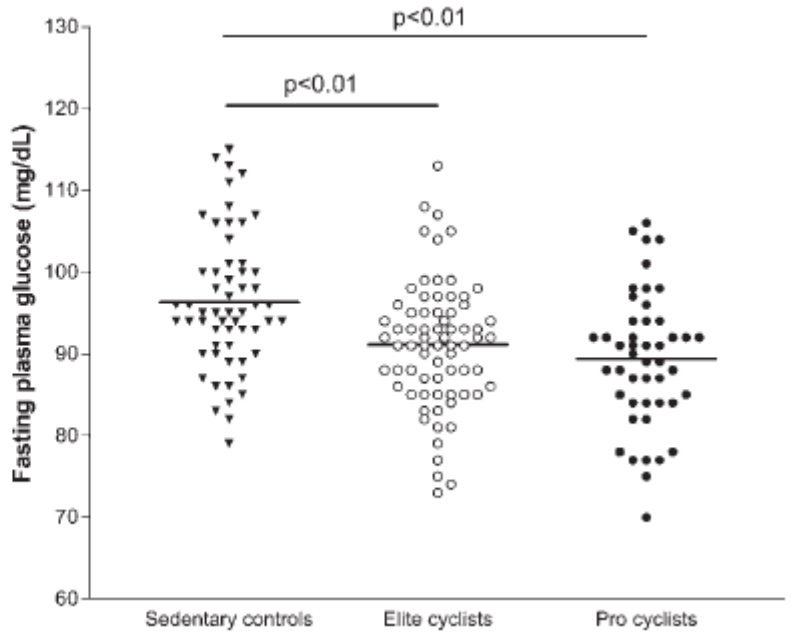
Glycaemic Control in Athletes

Int J Sports Med 2008; 29: 7 – 10

G. Lippi[1], M. Montagnana[1], G. L. Salvagno[1], M. Franchini[2], G. C. Guidi[1]

Physiology & Biochemistry





Clin Chem Lab Med 2006;44(3):322–326 © 2006 by Walter de Gruyter • Berlin • New York. DOI 10.1515/CCLM.2006.056

Comparison of the lipid profile and lipoprotein(a) between sedentary and highly trained subjects

Giuseppe Lippi[1,*], Federico Schena[2], Gian Luca Salvagno[1], Martina Montagnana[1], Filippo Ballestrieri[2] and Gian Cesare Guidi[1]

Table 1 Lipid profile in professional skiers and professional cyclists vs. healthy sedentary controls.

	Sedentary controls	Professional skiers	Professional cyclists
n	60	40	102
Age, years	27.1±5.1	26.7±4.7	27.2±3.9
Overall aerobic training, h/day	0.04±0.02	2.92±0.93[b]	2.84±0.42[b]
TC, mmol/L	5.09±0.93	4.59±0.66[b]	4.81±0.83[a]
LDL-C, mmol/L	3.46±0.88	2.77±0.88[b]	2.88±0.74[b]
HDL-C, mmol/L	1.35±0.27	1.66±0.28[b]	1.74±0.41[b]
Triglycerides, mmol/L	1.41±0.99	0.85±0.40[b]	0.92±0.44[b]
TC/HDL-C	3.91±0.99	2.83±0.48[b]	2.89±0.74[b]
AIP	−0.04±0.27	−0.32±0.18[b]	−0.30±0.25[b]
Lp(a), mg/L	82 (24–443)	93 (24–453)	65 (24–659)

LDL-C, low-density lipoprotein-cholesterol; HDL-C, high-density lipoprotein-cholesterol; TC/HDL-C, total cholesterol/HDL-C ratio; AIP, atherogenic index of plasma; Lp(a), lipoprotein(a). Results are expressed as mean±SD, with the exception of Lp(a) (median and 5–95th percentiles). Differences between athletes and sedentary controls were evaluated by unpaired Student's t-test. [a] $p<0.05$; [b] $p<0.01$.

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Comparison of the lipid profile and lipoprotein(a) between sedentary and highly trained subjects

Giuseppe Lippi[1,*], Federico Schena[2], Gian Luca Salvagno[1], Martina Montagnana[1], Filippo Ballestrieri[2] and Gian Cesare Guidi[1]

Table 2 Percentage of professional skiers and professional cyclists vs. healthy sedentary controls fulfilling the current NCEP and AHA/ACC desirable values for cardiovascular disease prevention.

	Sedentary controls	Professional skiers	Professional cyclists
TC (<5.2 mmol/L)	33/60 (55.0%)	32/40 (80.0%)[b]	70/102 (69.3%)[b]
LDL-C (<3.38 mmol/L)	26/60 (43.3%)	35/40 (87.5%)[b]	75/102 (73.5%)[b]
HDL-C (>1.04 mmol/L)	56/60 (93.3%)	40/40 (100%)[b]	101/102 (99.0%)[a]
Triglycerides (<1.65 mmol/L)	47/60 (78.0%)	38/40 (95.0%)[b]	95/102 (94.0%)[b]
TC/HDL-C (<3.5)	23/60 (38.3%)	35/40 (87.5%)[b]	85/102 (83.3%)[b]
AIP (<0)	37/60 (61.7%)	37/40 (92.5%)[b]	90/102 (88.2%)[b]
Lp(a) (<300 mg/L)	52/60 (86.7%)	33/40 (82.5%)	92/102 (84.4%)

LDL-C, low-density lipoprotein-cholesterol; HDL-C, high-density lipoprotein-cholesterol; TC/HDL-C, total cholesterol/HDL-C ratio; AIP, atherogenic index of plasma; Lp(a), lipoprotein(a). Differences between athletes and sedentary controls are evaluated by χ^2 test analysis. [a] $p<0.05$; [b] $p<0.01$.

Table 1. Variation of osteocalcin and parathyroid hormone before (pre), immediately after (post), and 3, 6 and 24 h after a 21-km, half-marathon run, in 15 male recreational athletes.[a]

	Pre	Post	3 h	6 h	24 h
Plasma volume change, %	—	–8.0 (1.0)[b]	–0.4 (1.0)	1.2 (1.1)	3.8 (1.0)[b]
Weight loss, %	—	8.8 (0.7)[b]	1.6 (0.7)	–0.1 (0.8)	–1.7 (0.7)[b]
Osteocalcin, μg/L	22.0 (2.5)	27.3 (3.0)[b]	21.6 (2.6)	20.2 (2.9)	22.3 (2.5)
Parathyroid hormone, pmol/L	3.1 (0.3)	6.4 (0.7)[b]	3.1 (0.3)	3.1 (0.5)	3.2 (0.3)

[a] Values are presented as geometric mean (SE). Differences from the premarathon values were evaluated by the Wilcoxon signed-rank test.
[b] $P < 0.01$, vs the pre-run sample.

Acute Variation of Osteocalcin and Parathyroid Hormone in Athletes after Running a Half-Marathon

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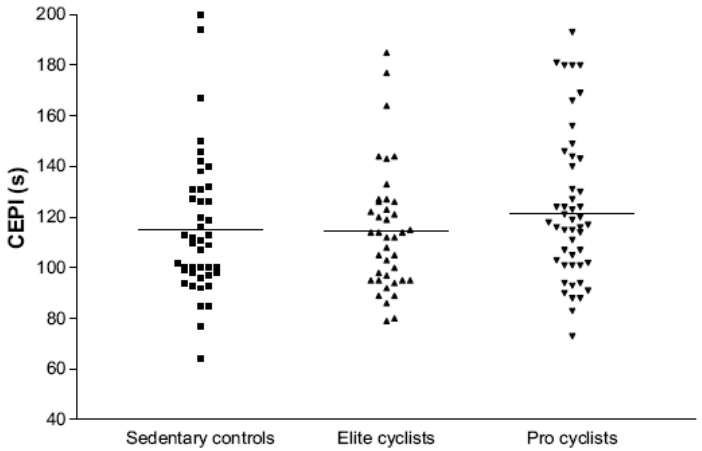
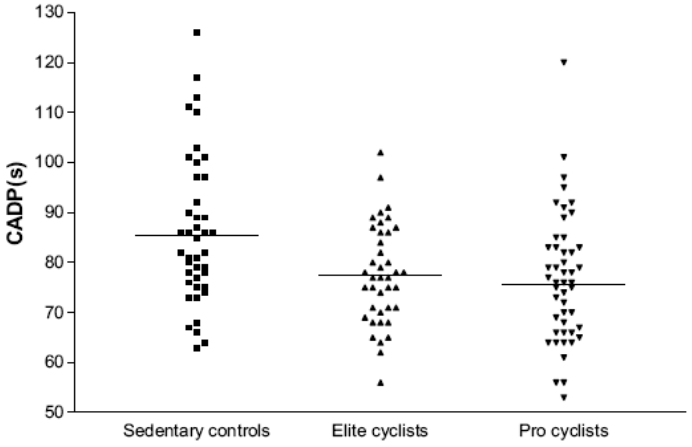
Comparison of platelet function between sedentary individuals and competitive athletes at rest

Giuseppe Lippi*[1], Martina Montagnana[1], Gian Luca Salvagno[1], Massimo Franchini[2] and Gian Cesare Guidi[1]





Measurement of morning saliva cortisol in athletes

Giuseppe Lippi [a,*], Francesco De Vita [b], Gian Luca Salvagno [a], Matteo Gelati [a], Martina Montagnana [a], Gian Cesare Guidi [a]

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There are several technical and biological advantages that make salivary samples as an easy and suitable biological approach for monitoring cortisol in athletes. Saliva samples offer a more practical alternative in a field-based setting than collecting blood specimens. Then, collection of salivary specimens is non-invasive and well tolerated by the athletes, since it does not require a venipuncture. Finally, saliva cortisol accurately reflects the biologically active free form of cortisol, thereby providing a more reliable measure than serum cortisol when testing the adrenocortical function [10].

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Review

Managing transferability of laboratory data

Gian Cesare Guidi [a,c,*], Giuseppe Lippi [a,c], Giovanni Pietro Solero [a], Giovanni Poli [a], Mario Plebani [b,d]

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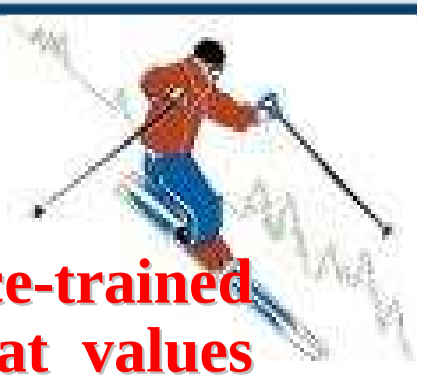
[d] *Centro di Ricerca Biomedica, Castelfranco Veneto (TV), Italy*

Quality performances resulting from widespread implementation of common reference intervals and longitudinal comparison of patient's data, will allow clinical laboratories to accomplish with a major transferability, amplifying health benefits and meeting increasing health systems demand.

Conclusions



- **Biochemical measurements in endurance-trained professional athletes at rest demonstrate that values lying outside the conventional reference ranges might reflect normal adaptations to regular and demanding physical exercise instead of underlying pathologies.**
- **Owing to high-intensity regular training-induced variations of plasma volume and metabolites, the interpretation of biochemical data in elite and top-class athletes equires caution, as results falling outside the conventional reference ranges do not always reflect underlying pathologies**

Conclusions

The quality performances resulting from the current technology advancements allow clinical laboratories to fully accomplish transferability of data through common IRs use, increasing citizens outcome and benefits and meeting health system expectations.