Original

Effects of physical charges on uric acid, creatinine and urea in college athletes

Efectos de las cargas físicas sobre el ácido úrico, creatinina y urea en deportistas universitarios

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ABSTRACT

Introduction: Metabolic indicators are biochemical markers that help to identify the health effects or not of physical stimulus, helping to make decisions related to directing specific sports training process and educational process in general.

Objective: To analyze values of renal profile (uric acid, creatinine and urea) in athletes of the Centro de Educación Física de la Escuela Superior Politécnica del Chimborazo (ESPOCH).

Methods: A representative sample (99 subjects, both sexes) of university athletes was studied, studying some renal indicators (uric acid, creatinine and urea) of interest to determine the assimilation levels in physical load.

Results: The average value obtained in uric acid was 4.2 mg/dL (Normal Level), the average value in creatinine of 0.6 mg/dL, with 10 subjects qualified qualitatively with a Low level (9.09%) and the rest with a qualitative qualification of Normal level, while the average value in urea was of 25.9 mg/dl (Normal Level). The linear correlations established between the three metabolic variables studied showed a weak positive influence.

Conclusions: The indicators obtained show a correct adaptation to physical load in university athletes under study, except for some particularities to be taken into account.

Keywords: uric acid, creatinine, urea, university students.

RESUMEN

Introducción: Los indicadores metabólicos son marcadores bioquímicos que ayudan a identificar los efectos saludables o no del estímulo físico, ayudando a la toma de decisiones relacionadas con el proceso de dirección del entrenamiento deportivo en específico y el proceso docente-educativo en general.

Objetivo: Analizar valores del perfil renal (ácido úrico, creatinina y urea) en deportistas del Centro de Educación Física de la Escuela Superior Politécnica del Chimborazo (ESPOCH).

Métodos: Se estudió una muestra representativa (99 sujetos, ambos sexos) de deportistas universitarios, estudiando algunos indicadores renales (ácido úrico, creatinina y urea) de interés para determinar los niveles de asimilación de la carga física.

Resultados: El valor promedio obtenido en ácido úrico fue de 4,2 mg/dL (Nivel Normal), el valor promedio en creatinina de 0,6 mg/dL, con 10 sujetos calificados cualitativamente con un nivel Bajo (9,09 %) y el resto con una calificación cualitativa de nivel Normal, mientras que el valor promedio en urea fue de 25,9 mg/dl (Nivel Normal). Las correlaciones lineales establecidas entre las tres variables metabólicas señaladas evidenciaron una influencia positiva débil.

Conclusiones: Los indicadores obtenidos demuestran una adaptación correcta a la carga física en los deportistas universitarios sometidos a estudio, salvo algunas particularidades a tener en cuenta.

Palabras clave: ácido úrico, creatinina, urea, estudiantes universitarios.

INTRODUCTION

In athletes who perform intense physical exercise, a metabolic acidosis originates,[1,3] the clinical disorder is characterized by a decrease in blood pressure and the concentration of $HC0_3$ accompanied by a compensatory hyperventilation that results in a fall in $pC0_2$; occurring in two ways: by acid addition or by the $HC0_3$ loss.

The main causes of lactic acid increase in come from excess physical work,4-6 exceeding the tolerance limits, either by using too intense loads, by prolonging the training time or by rest lack, by not respecting the adequate rest periods, and even for inadequate nutrition and hydration.[5,7]

The excessive and continuous release of lactate could generate a metabolic acidosis, considered as an excessive accumulation of lactic acid in anaerobic conditions, because the body tries to transform energy in aerobic conditions when it is insufficient, the body replenishes energy through of lactic acid formation, whose excessive accumulation can generate muscular fatigue that will impede physical activity.[8,9] In programmed training, a large amount of pyruvic acid is produced under anaerobic conditions (oxygen absence), in order to maintain muscle contraction, the greatest part of this acid is transformed into lactic acid.[10]

The determination of Urea levels, Uric Acid and Creatinine (nitrogen metabolites) as part of intervention processes with controlled physical stimuli, is a substantial part of management process in high-performance sports training,[11,13] and to determine diverse conditions.[14,15] In the case of specialized sports training, pre- and post-training studies are carried out, determining whether the physical effort exceeds the established limits,[4] as it could be affectation to kidney when there is a greater blood filtration, as well as proteinuria and haematuria due only to physical exertion, which is eliminated in 24 to 48 hours, if it persists, it is considered a pathological process that would induce self-regulation in the application of physical stimulation and even prophylactic medication.

At the Centro de Educación Física de la Escuela Superior Politécnica de Chimborazo (ESPOCH), students who perform their sporting activities have the possibility of presenting muscle aches that can lead to more severe pathologies such as overtraining and various injuries,[16-18] given that a significant percentage of students have not been high performance athletes, and therefore do not have a bioadaptation to prolonged or brief effort, aspect required to fulfill some university teaching requirements as part of career curriculum in Physical activity.

Under these questions, it is useful to control the physical loading effect on athletes of the ESPOCH, so it is evident as investigation purpose to analyze values of renal profile, such as uric acid, creatinine and the urea level in athletes of the Centro de Educación Física de la Escuela Superior Politécnica del Chimborazo.

METHODS

For the socialization of research, the link was made between teachers of the Physical Education Center and selected athletes from the different sports disciplines of ESPOCH (Athletics, Ecuavoley, Soccer, Gymnastics, Tennis, Taekwondo and Volleyball), 99 students of both sexes attended freely, and this value is a representative sample of studied population. The reagents used in the investigation will be:

- Reagent for UREA determination

- RGT1 Reagent 1; Phosphate buffer (pH 7); Sodium salicylate; Nitro prussiate sodium; EDTA; RGT2 Reagent 2; Phosphate buffer (pH <13); Hypochlorite; ENZ Enzyme; Urease; STD Pattern; Urea; Equivalent to BUN; Sodium azide
- Reagent for determination of Uric Acid HUMAN
- RGT Enzymatic reagent; Phosphate buffer (pH 7.5); 4-aminophenazone; DCHBS; Uricasa; Peroxidase; STD Pattern; Uric Acid and Sodium Azide.
- Reagent for determination of Creatinina Human.
- PIC; NaOH; STD

The data collection was performed during 2 consecutive weeks from 06:30 to 09:00 in facilities of the Physical Education Center. The renal profile analysis was performed in the Clinical Laboratory of ESPOCH Sciences Faculty before starting the usual training session for each athlete. Linear parametric (Pearson) and nonparametric (Spearman) correlations were applied according to normality distribution obtained with Kolmogorov-Smirnov test.

RESULTS

Table 1 shows the reference values of 99 students studied for the variable "uric acid", obtaining a maximum value of 6.9mg/dL and a minimum value of 2.4mg/dL, for an average of 4,2mg/dL, indicating a qualitative rating of Normal in all cases studied.

Table 1. Determination of average uric acid reference values before starting the class sesión

No	**URIC ACID**	
	BEFORE	**REFERENCE VALUE**
1	4,1	NORMAL
2	4,3	NORMAL
3	2,9	NORMAL
4	4,1	NORMAL
5	4,3	NORMAL
6	4,3	NORMAL
7	5,9	NORMAL
8	3	NORMAL
9	5,4	NORMAL

10	6,2	NORMAL
11	4,7	NORMAL
12	6,4	NORMAL
13	5,1	NORMAL
14	3,7	NORMAL
15	3,7	NORMAL
16	3,3	NORMAL
17	4,5	NORMAL
18	4,6	NORMAL
19	2,8	NORMAL
20	2,4	NORMAL
21	3,9	NORMAL
22	4,1	NORMAL
23	3,5	NORMAL
24	6,2	NORMAL
25	4,8	NORMAL
26	6,6	NORMAL
27	3	NORMAL
28	4,6	NORMAL
29	4,6	NORMAL
30	3,7	NORMAL
31	3,2	NORMAL
32	3	NORMAL
33	3,4	NORMAL
34	5,2	NORMAL
35	4,9	NORMAL
36	5,8	NORMAL
37	3,6	NORMAL
38	4,6	NORMAL

39	3,7	NORMAL
40	3,8	NORMAL
41	3	NORMAL
42	4,2	NORMAL
43	3,3	NORMAL
44	4	NORMAL
45	6,1	NORMAL
46	4,2	NORMAL
47	3,9	NORMAL
48	3,8	NORMAL
49	2,8	NORMAL
50	4,4	NORMAL
51	2,5	NORMAL
52	4,2	NORMAL
53	2,6	NORMAL
54	3,1	NORMAL
55	4,9	NORMAL
56	2,7	NORMAL
57	2,5	NORMAL
58	2,4	NORMAL
59	2,6	NORMAL
60	4,6	NORMAL
61	5,6	NORMAL
62	5,6	NORMAL
63	6,4	NORMAL
64	5,5	NORMAL
65	3,9	NORMAL
66	2,6	NORMAL
67	2,7	NORMAL

68	4,9	NORMAL
69	3,5	NORMAL
70	6,2	NORMAL
71	5,1	NORMAL
72	4,8	NORMAL
73	5,5	NORMAL
74	5,5	NORMAL
75	6,8	NORMAL
76	2,9	NORMAL
77	2,4	NORMAL
78	6,7	NORMAL
79	4,3	NORMAL
80	3,1	NORMAL
81	3,3	NORMAL
82	4,4	NORMAL
83	4	NORMAL
84	3,7	NORMAL
85	4,6	NORMAL
86	4,4	NORMAL
87	3	NORMAL
88	2,7	NORMAL
89	5,5	NORMAL
90	6,9	NORMAL
91	4,3	NORMAL
92	3,3	NORMAL
93	2,8	NORMAL
94	5,6	NORMAL
95	6,8	NORMAL
96	4,1	NORMAL

97	3,6	NORMAL
98	5,7	NORMAL
99	3,1	NORMAL
Average	4,2	NORMAL
Mín.	2,4	
Máx.	6,9	

Table 2 shows the individual values obtained in the variable creatinine, where the maximum value was established at 1.1mg/dL, the minimum value at 0.4mg/dL, with an average of 0.6 mg/dL. Of the total sample studied, 10 subjects were qualitatively qualified with a Low level (9.09%), and the rest of the subjects studied obtained a Normal qualitative rating.

Table 2. Determination of reference values of average creatinine before starting the class sesión

No	**CREATININE**	
	BEFORE	**REFERENCE VALUE**
1	1	NORMAL
2	0,9	NORMAL
3	1,1	NORMAL
4	1,1	NORMAL
5	1,1	NORMAL
6	1,1	NORMAL
7	1,1	NORMAL
8	1,1	NORMAL
9	0,9	NORMAL
10	0,5	NORMAL
11	0,4	LOW
12	0,9	NORMAL
13	0,5	NORMAL
14	0,5	NORMAL
15	0,8	NORMAL
16	1	NORMAL

17	0,5	NORMAL
18	0,4	LOW
19	0,5	NORMAL
20	0,5	NORMAL
21	1,1	NORMAL
22	1,1	NORMAL
23	0,6	NORMAL
24	0,5	NORMAL
25	0,6	NORMAL
26	0,6	NORMAL
27	0,5	NORMAL
28	0,5	NORMAL
29	0,6	NORMAL
30	0,5	NORMAL
31	0,5	NORMAL
32	0,8	NORMAL
33	0,5	NORMAL
34	0,5	NORMAL
35	0,5	NORMAL
36	0,8	NORMAL
37	0,5	NORMAL
38	0,8	NORMAL
39	0,8	NORMAL
40	0,5	NORMAL
41	0,5	NORMAL
42	0,6	NORMAL
43	0,5	NORMAL
44	0,9	NORMAL
45	0,5	NORMAL

46	0,5	NORMAL
47	0,8	NORMAL
48	0,5	NORMAL
49	0,4	LOW
50	0,5	NORMAL
51	0,5	NORMAL
52	0,9	NORMAL
53	0,5	NORMAL
54	0,5	NORMAL
55	0,5	NORMAL
56	0,5	NORMAL
57	0,5	NORMAL
58	0,5	NORMAL
59	0,5	NORMAL
60	0,7	NORMAL
61	0,4	LOW
62	0,5	NORMAL
63	1,1	NORMAL
64	0,6	NORMAL
65	0,5	NORMAL
66	0,4	LOW
67	0,5	NORMAL
68	0,7	NORMAL
69	0,8	NORMAL
70	1,1	NORMAL
71	0,5	NORMAL
72	0,5	NORMAL
73	0,5	NORMAL
74	0,6	NORMAL

75	0,9	NORMAL
76	0,5	NORMAL
77	0,4	LOW
78	0,7	NORMAL
79	1	NORMAL
80	0,5	NORMAL
81	0,4	LOW
82	0,6	NORMAL
83	0,4	LOW
84	0,5	NORMAL
85	0,7	NORMAL
86	0,6	NORMAL
87	0,5	NORMAL
88	0,5	NORMAL
89	0,5	NORMAL
90	0,6	NORMAL
91	0,4	LOW
92	0,5	NORMAL
93	0,5	NORMAL
94	0,6	NORMAL
95	1,1	NORMAL
96	0,5	NORMAL
97	0,7	NORMAL
98	0,4	LOW
99	0,5	NORMAL
Average	0,6	NORMAL
Mín.	0,4	
Máx.	1,1	

Table 3 shows the individual data obtained as part of urea variable, obtaining a maximum value of 45.8 mg/dl and a minimum value of 14.6mg/dl, for an average or 25.9mg/dl. All the studied sample obtained a qualitative qualification in normal urea levels, coinciding with the indicators obtained in uric acid.

Table 3. Determination of reference values of average urea before starting the class sesión

No	UREA	
	BEFORE	REFERENCE VALUE
1	16,3	NORMAL
2	22,1	NORMAL
3	21,6	NORMAL
4	15,4	NORMAL
5	39,9	NORMAL
6	22,9	NORMAL
7	26,1	NORMAL
8	14,6	NORMAL
9	33,7	NORMAL
10	33,3	NORMAL
11	45,8	NORMAL
12	32,1	NORMAL
13	24,8	NORMAL
14	24,2	NORMAL
15	23,7	NORMAL
16	32,1	NORMAL
17	27,7	NORMAL
18	25,7	NORMAL
19	24,4	NORMAL
20	20,9	NORMAL
21	30,6	NORMAL
22	24,1	NORMAL

23	28,4	NORMAL
24	18,5	NORMAL
25	29,5	NORMAL
26	24,5	NORMAL
27	28,2	NORMAL
28	22,2	NORMAL
29	26,8	NORMAL
30	33,4	NORMAL
31	27,5	NORMAL
32	26,5	NORMAL
33	20,6	NORMAL
34	20,8	NORMAL
35	22,8	NORMAL
36	23,5	NORMAL
37	26,7	NORMAL
38	29,6	NORMAL
39	21,3	NORMAL
40	22,2	NORMAL
41	19,7	NORMAL
42	20,2	NORMAL
43	21,6	NORMAL
44	34,2	NORMAL
45	20,3	NORMAL
46	26,1	NORMAL
47	22,1	NORMAL
48	27,8	NORMAL
49	25,2	NORMAL
50	21,5	NORMAL
51	22,2	NORMAL

52	23,6	NORMAL
53	16,8	NORMAL
54	19,5	NORMAL
55	27,9	NORMAL
56	25,3	NORMAL
57	30,7	NORMAL
58	18,7	NORMAL
59	20	NORMAL
60	45,6	NORMAL
61	19,1	NORMAL
62	28,6	NORMAL
63	39,3	NORMAL
64	28,9	NORMAL
65	27,2	NORMAL
66	41,6	NORMAL
67	23,9	NORMAL
68	27,7	NORMAL
69	31,5	NORMAL
70	25,1	NORMAL
71	31,7	NORMAL
72	27	NORMAL
73	28,1	NORMAL
74	38,3	NORMAL
75	34,3	NORMAL
76	22,6	NORMAL
77	24,3	NORMAL
78	30,3	NORMAL
79	18,2	NORMAL
80	18,4	NORMAL

81	24,8	NORMAL
82	20,9	NORMAL
83	21,7	NORMAL
84	29	NORMAL
85	18,6	NORMAL
86	30	NORMAL
87	18,4	NORMAL
88	20,5	NORMAL
89	25,5	NORMAL
90	33,4	NORMAL
91	23	NORMAL
92	21,1	NORMAL
93	24,5	NORMAL
94	26	NORMAL
95	32,2	NORMAL
96	26,4	NORMAL
97	19,5	NORMAL
98	27,9	NORMAL
99	26,2	NORMAL
Average	25,9	NORMAL
Mín.	14,6	
Máx.	45,8	

DISCUSSION

In the results analysis, the differences between the sexes must be taken into account, given that many performance indicators differ according to gender.[19] For the present case, some scales that determine the qualitative levels vary according to gender, the normal indicators in uric acid level for the female sex are between 3 & 6.5 mg/dL to between 4.5 to 8.2 mg/dL for men,[20] while normal creatinine indicators are 0.7 to 1.3 mg/dL (61.9 to 114.9 µmol/L) for men and 0.6 to 1.1

mg/dL (53 to 97.2 µmol / L) for women.[21] On the other hand, the normal blood urea indicators used for both sexes are located at a lower level of 40 mg/dL.[22]

In another sense, the linear correlations established between uric acid and creatinine showed a bilateral significance of p=0.006, establishing Spearman's Rho in ,275, for a weak positive correlation, while the linear correlation established between uric acid and urea also showed a bilateral significance (p=0.001), for a positive correlation of Pearson in ,320 (weak). On the other hand, the linear correlation between the urea indicator and creatinine indicator did not show significant differences (p = 0.286), nor did it obtain a satisfactory correlation indicator with Spearman's Rho (Weak: ,108). In this sense, it has not been possible to demonstrate solidly the effects of one indicator on another; therefore, the determination of a metabolite of studied ones does not indicate significant positive influences in other metabolites under study.

Although it is useful to determine of uric acid values, creatinine and urea in university athletes as a research objective, it is recommended to extend of research field to other metabolites, including organic responses before, during and after the initiation of a specific training plan, such as and as it is concretized in Vásquez; Riquetti; & Morales[4] with lactic acid.

FINAL CONSIDERATIONS

From the view point of metabolites uric acid, creatinine and urea, the indicators obtained show a correct adaptation to physical load in the subjects studied, except for some particularities to be taken into account, which according to principle of pedagogical individualization must be differentiated, taking the pertinent actions from the physical education curriculum to avoid overload syndromes and the reduction of athletic and academic performance.

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Interest conflict declaration

The authors declare that they do not have any type of interests conflict.