

**INTRODUCTION AND AIM**

Very few studies have been recently published on systemic and urinary disorders (rhabdomyolysis, proteinuria, hematuria) appearing in extreme physical exercise. The analysis of changes suffered by healthy subjects undergoing strenuous exercise can help us to get insight into the pathophysiology of exercise-induced inflammation and its systemic, cardiovascular and renal effects, and to establish the basis for future trials with agents designed to block these inflammatory mechanisms and its harmful effects, being this applicable to other scenarios. Our main goal is to determine the changes in serum markers of inflammation and the prevalence of urinary sediment abnormalities in a population of healthy subjects after participating in a mountain ultramarathon with an average exercise duration of 19 hours. Our second goal is to detect differences in this parameters between patients who abandoned early and those who did not.

PROYECTO  
**PENYAGOLOSA**  
*Trail Saludable*

**MATERIAL AND METHODS**

Research was developed at the Spanish Ultra-Trail Penyagolosa Endurance Championship race in May 2015. The track consisted of 118 km with a positive overall elevation of 4227 m. Among 500 ultra-endurance athletes fifty volunteers were recruited. Bioimpedance data, vital signs, blood and urine samples were collected before and after the race.



**BASAL CHARACTERISTICS**

Variable	n(%) / Media ± SD / Median (IQR)
<b>ENVIRONMENTAL DATA</b>	
Environmental temperature at start line (°C)	23,20
Atmospheric pressure at start line (milibars)	1015
Relative humidity at start line (%)	48
<b>EPIDEMIOLOGIC DATA</b>	
Age (years)	40,12 ± 7,08
Sex (men)	46 (92)
Smoking	4 (8)
Hypertension	5 (10)
Antihypertensive treatment	3 (6)
Family history of diabetes	7 (14,3)
Family history of hypertension	13 (26)
Family history of ischemic cardiopathy	14 (28)
Family history of chronic kidney disease.	2 (4)
Frequent NSAIDs intake	5 (10)

**PHYSIOLOGICAL CHANGES**

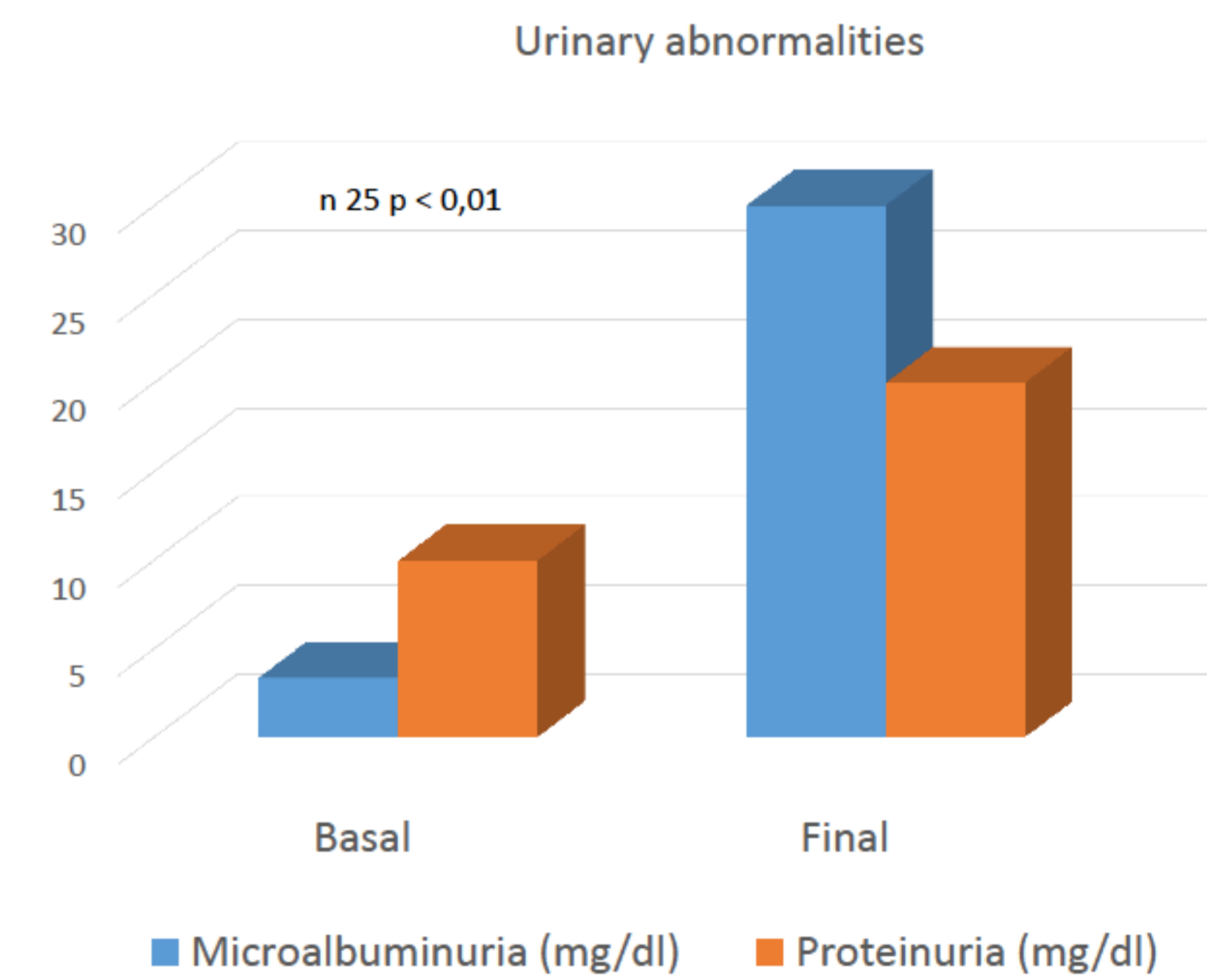
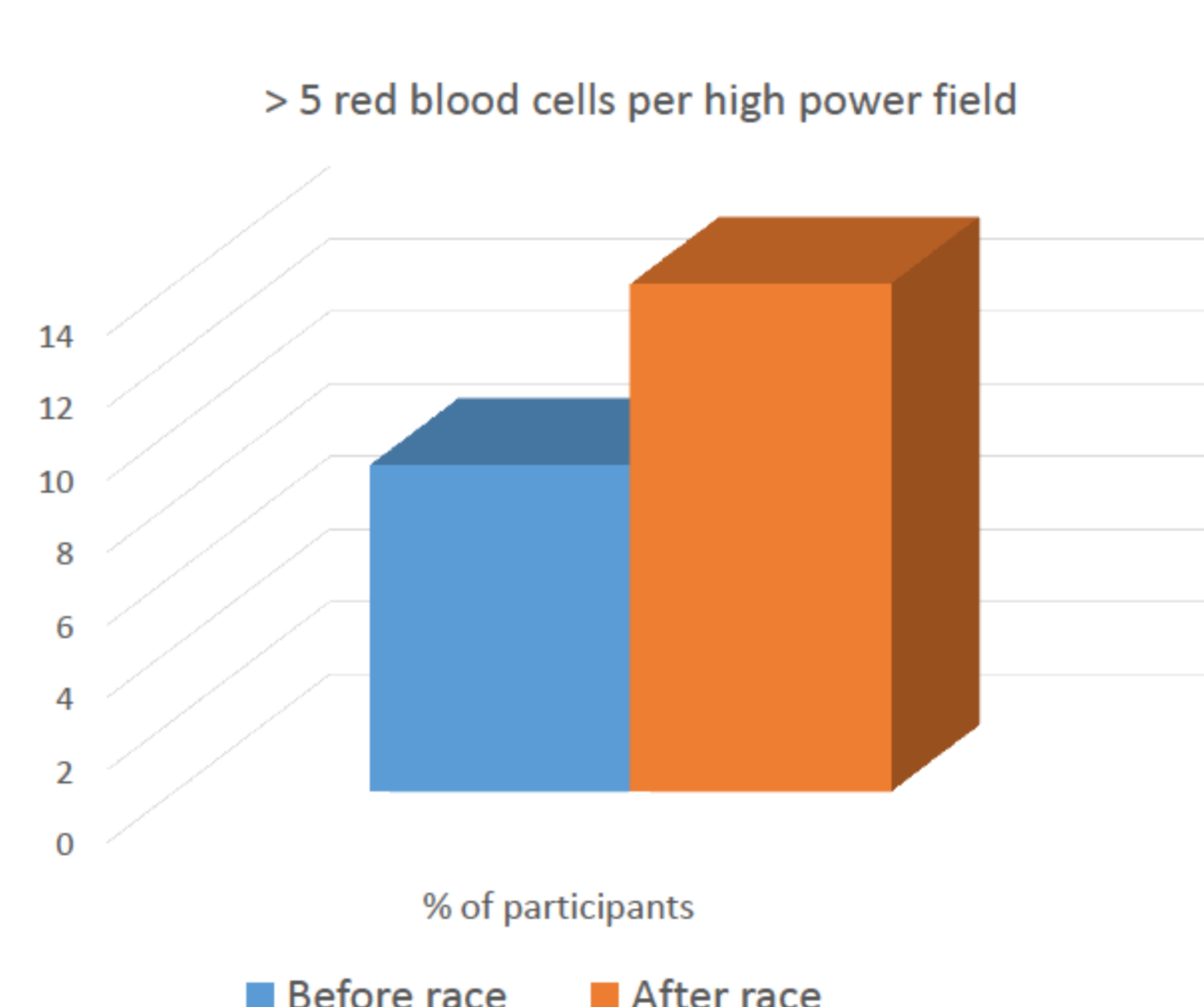
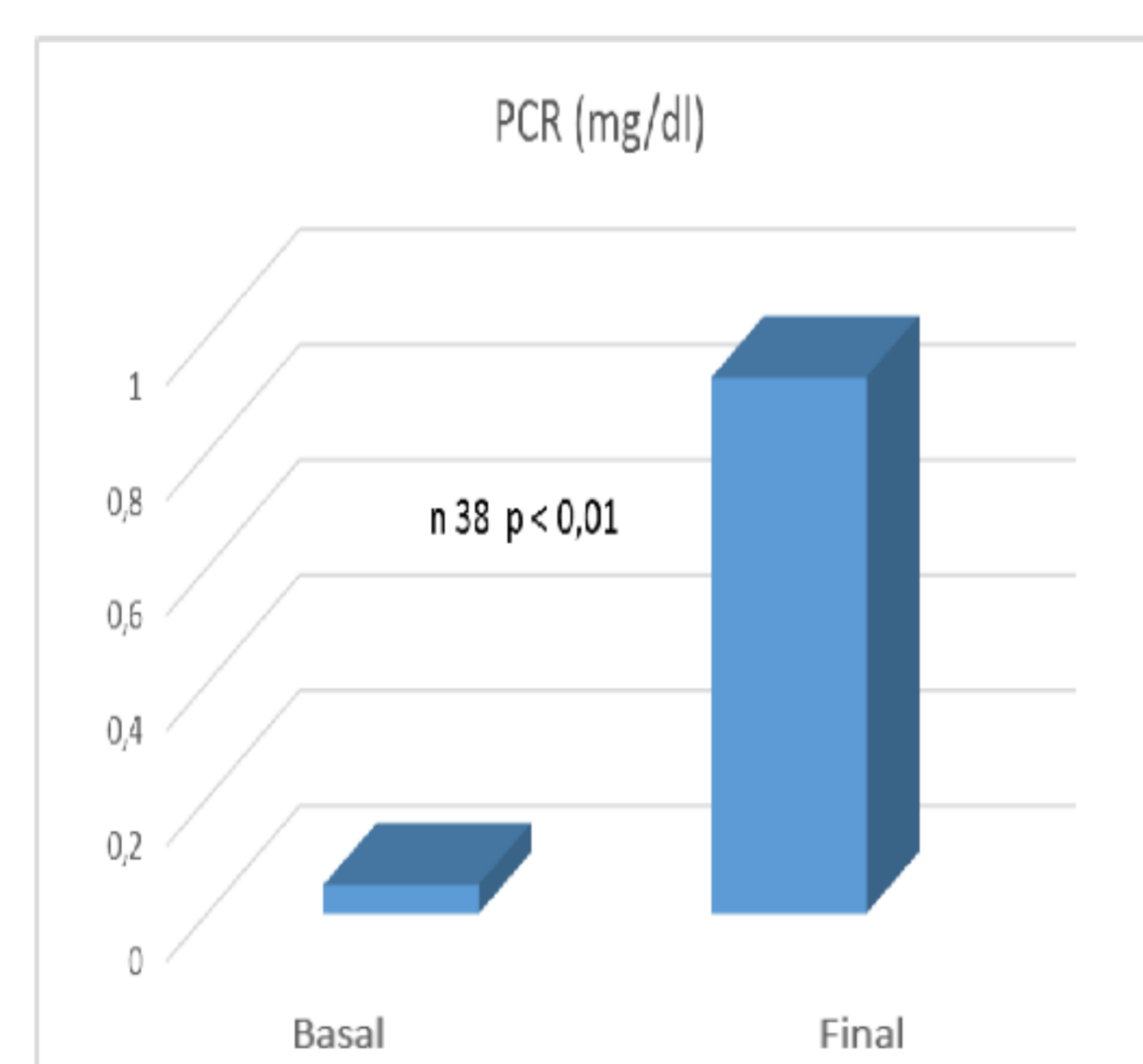
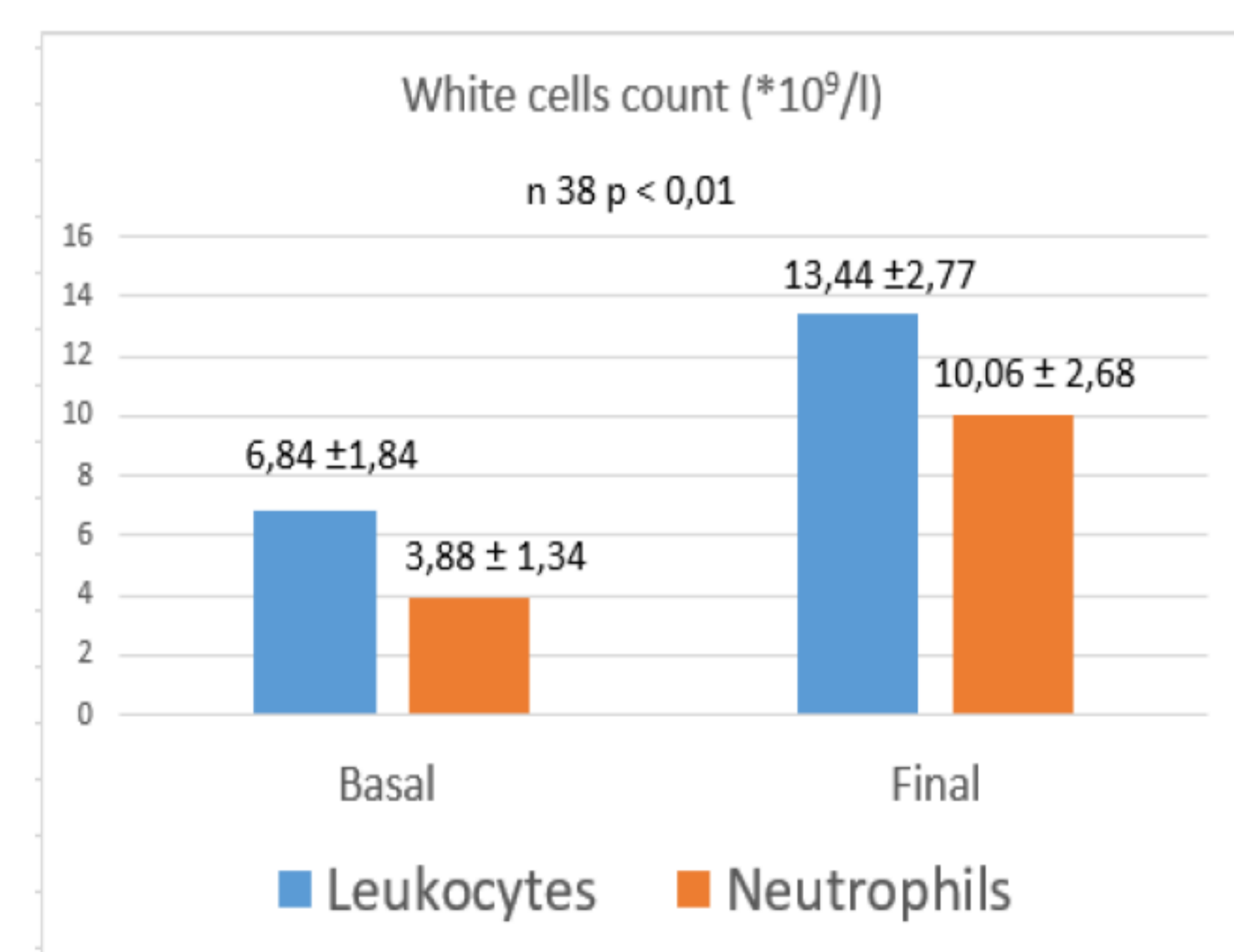
Variable	Basal	Final	p
<b>VITAL SIGNS (n 37)</b>			
SAP (mm de Hg)	136,62 ± 15,77	115,84 ± 11,76	<0,01
DAP (mm de Hg)	88,54 ± 8,42	77,73 ± 10,26	<0,01
HR (lpm)	74,38 ± 8,61	91,49 ± 13,78	<0,01
Corporal temperature (°C)	34,70 ± 0,72	35,53 ± 0,81	<0,01
<b>BODY COMPOSITION (n 30-35)</b>			
BMI (kg/m <sup>2</sup> ) n 35	24,44 ± 2,3	22,88 ± 4,56	0,06
Fat tissue (kg) n 30	9,86 ± 3,87	9,77 ± 3,63	0,20
Lean tissue (kg) n 31	58,64 ± 14,17	57,64 ± 6,60	0,84
Tota Body Water (l) n 30	44,72 ± 5,52	42,10 ± 4,82	<0,01
<b>BLOOD TESTS (n 38)</b>			
Hematocrit (%)	42,17 ± 2,53	42,01 ± 3,12	0,33
Leukocytes (*10 <sup>9</sup> /l)	6,84 ± 1,84	13,44 ± 2,77	<0,01
Neutrophils (*10 <sup>9</sup> /l)	3,88 ± 1,34	10,06 ± 2,68	<0,01
CK (U/l)	165,5 (117,75-211,50)	2568,50 (1491,90-4804,75)	<0,01
LDH (U/l)	177,96 ± 36,58	334,50 ± 92,36	<0,01
Troponin (ng/l)	0,00 (0,00-3,25)	8,00 (5,2-12,95)	<0,01
PCR (mg/dl)	0,05 (0,02-0,11)	0,93 (0,44-1,55)	<0,01
<b>URINARY TESTS (n 25)</b>			
Microalbuminuria (mg/dl)	3,35 (1,62-5,75)	30 (7-72,50)	<0,01
Urinary Albumin/creatinine rate (ACR) (mg/g)	2,50(1,50-3,92)	14 ( 5,00-34,50)	<0,01
(ACR>30 mg/g)	0 (0%)	8(32%)	
Proteinuria (mg/dl)	9,95 (6,20-16,05)	20 (12,50-25,50)	0,02
Urinary sodium (mEq/l)	119,50 (91,25-173,50)	69,00 (37,25-119,75)	<0,01
Hematuria	9 (36%)	14 (56%)	0,23

**ACKNOWLEDGEMENTS**



Qualitative variables represented as n(%). SD:Standard deviation. IQR: Interquartile Range. Quantitative variables with no normal distribution are represented as Median (IQR).

Physiological changes observed after the race. Paired samples T-Student test. Paired samples ANOVA test in case of n<30 or abnormal variable distribution. Mc. Nemar Test for binomial qualitative variables.



**RESULTS**

Of the 50 participants, 46 (92%) were male, 4 (8%) smokers. 10% admitted regular use of NSAIDs.; 34 (68%) completed the 118 kilometer race. The average duration of the exercise was 19 hours and 8 minutes. No significant differences were found between those individuals who completed the race and those who abandoned. In the multivariate analysis no independent predictor of early abandonment was found. Appart from the drop in systolic (SAP) and diastolic blood pressure (DAP) values, increased heart rate (HR) and the expected increase in serum muscular enzymes, we found an important increase of inflammatory parameters as well a significant increase in proteinuria at the expense of increased microalbuminuria. Unlike previously published results, we did not observe a significant increase in the percentage of patients with hematuria before and after the sporting event. This may be due to the small sample size or the high frequency of basal hematuria, which we attribute to residual effects of previous training.

**CONCLUSIONS**

Extreme exertion leads to microalbuminuria and systemic inflammation. After the race we did not found a significant increase in the number of athletes presenting with microhematuria, which was initially highly prevalent among our population. The results of this study encourage us to develop similar studies, with serial controls to confirm longterm impact of these alterations and the factors that influence recovery from them.