

SERUM ELECTROLYTE FLUCTUATIONS AND RENAL FUNCTION CHANGES AFTER EXERCISE IN UNDERGRADUATE FOOTBALLERS

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ABSTRACT	KEYWORDS
<p>Background: Prolonged physical exercise is known to cause fluid and electrolyte loss through sweating, potentially altering serum biochemical parameters. These changes may impact physiological functions, especially under inadequate hydration.</p> <p>Aim: This study evaluated the effect of physical exercise on serum electrolytes, urea, and creatinine levels in undergraduate footballers in Anambra State, Nigeria.</p> <p>Method: A total of 66 male footballers, divided into three groups of 22 players each, participated in 2-hour football sessions with a 15-minute halftime break. Participants were permitted only 250 mL of water during the session. Blood samples were collected before exercise, within 5 minutes post-exercise, and 2 hours post-exercise. Serum concentrations of sodium, potassium, chloride, bicarbonate, and calcium were determined using ion-selective electrodes. Urea and creatinine levels were analyzed via standard colorimetric methods.</p> <p>Results: There were no statistically significant changes ($P > 0.05$) in the mean serum concentrations of sodium (Na^+), potassium (K^+), chloride (Cl^-), and bicarbonate (HCO_3^-) before and after the exercise. However, serum calcium (Ca^{2+}) levels increased significantly post-exercise ($P < 0.05$). Urea and creatinine levels showed no significant variation.</p> <p>Conclusion: The study suggests that short-duration football activity under limited hydration does not significantly alter major serum electrolytes, urea, or creatinine levels, although calcium levels may rise post-exercise. These findings may have implications for hydration and nutritional strategies in athletic training.</p>	<p>Physical Exercise, Serum Electrolytes, Footballers, Calcium, Hydration</p>

Introduction

Individuals engaged in strenuous exercise have a higher requirement for some minerals compared to sedentary individuals due to increased rates of urinary and sweat losses. Inadequate intake of some essential minerals may lead to the development of some disease states.

Although a significant number of athletes and professionals in the sports medicine field believe in effect of mineral supplements, there are remarkably few data supporting a positive effect of dietary mineral supplementation on athletic performance. However, this research is targeted to determine if strenuous exercise does influence loss of several minerals and to determine if the loss of those minerals is significant enough to cause deleterious effect.

Materials and Methods

Subjects

This study was conducted at the training field of Chukwuemeka Odumegwu Ojukwu University, Uli. This was done during the weekend physical exercise activities done by the students of the university. Sixty (60) subjects were recruited, randomly from footballers.

Sample Size

Sample size calculation was done using 95% confidence interval, 0.05 precision and prevalence rate. There seem to be no data available as regards the proportion of Anambra State residents that participate in various forms of physical exercise, but, high physical activity levels assessed in Ibadan, Western Nigeria, reported 3.2% (Odunaiya et al., 2010).

The formula for sample size when population is more than 1000 is: $n =$

$$Z^2PQ/d^2$$

$$n = Z^2PQ/d^2$$

Where:

n = minimum sample size,

Z = standard normal deviation at 95% confidence interval which is 1.96,

d = degree of precision (taken as 0.05),

P = proportion of the target population (estimated at 3.2% which is $3.2/100 = 0.032$),

Q = alternate proportion (1- P) which is $1-0.032 = 0.968$ $n = (1.96)^2 (0.032)(0.968) / (0.05)^2 = 48$

Inclusion Criteria

(i) Subjects were made up of only males of between 18-30 years. (ii) Subjects must not have participated in any strenuous exercise for at least one month.

(iii) Subjects must not have any history of medical illness.

(iv) Subjects must not be recently on medicinal drug use.

Recruitment of subjects: After verbal consent, detailed personal, and medical questionnaire was completed by the footballers through personal interview.

Ethical Approval: Ethical approval was gotten from the research Ethics committee of faculty of Basic Medical Sciences.

Pre exercise, exercise and post exercise period

Six football teams comprising of 11 players each was group into 3 sets. Each set containing 22 players were allowed to play for at least 2 hours with a 15 minutes break interval. They were allowed to take only 250mls water during this exercising period.

Pre-Exercise Blood Samples:

Blood samples were collected from all the subjects prior to the exercise from antecubital veins with the subjects in sitting position. Post-Exercise blood Samples were collected within 5 minutes after and 2 hrs after the exercise. The blood samples were also analyzed for serum electrolytes, urea and creatinine. Blood sample for calcium was collected after removing the tourniquet for 2 minutes. All blood samples were stored in a sealed containers tubes

and were later centrifuged at 4000 revolution per minute (RPM) for 10 minutes and the serum of each sample was extracted into fresh plain bottle for analysis, while those not immediately analyzed were stored at – 20 degree celsius until analysis few days later. The blood samples were analyzed for serum electrolytes, urea and creatinine.

Methods for Analysis

Electrolyte determination using ion selective electrode Electrolytes were determined using ion selective electrode by Bard and Faulkner (2000).

Estimation of Serum Sodium estimation was done using sodium reagent set by Teco Diagnostics.

Estimation of Serum Potassium: Potassium estimation was done using Turbidimetric test-TPB method of the test kit by Quimica Clinical Aplicada S.A.

Determination of Serum Bicarbonate by modified method of Von-Slyke **Determination of Urea Level** (Roche Diagnostics, USA).

Blood urea was determined by the method described by Kassirer, (1971).

Determination of Creatinine Level (Roche Diagnostics, USA).

Serum creatinine was estimated by Jaffe's method as described by Laron, (1972).

Statistical Analysis

Data was statistically analyzed using Statistical Package for the Social Sciences (SPSS) for windows version 20.0 software. All data were expressed as Mean \pm Standard Deviation (SD). Statistical analysis of before exercise, two weeks after exercise and four weeks after exercise data was performed by Analysis of Variance (ANOVA) while multiple comparisons were done using Post Hoc test. Significance was fixed at $P < 0.05$.

Results and Discussion

In this study (Table 1), there was no significant difference in mean concentrations of serum electrolytes (Na^+ , K^+ , Cl^- and HCO_3^-) profile levels in exercising subjects when compared with the post exercising group. ($P > 0.05$). However, the mean levels of Ca^{++} increased significantly in exposed group when compared with the control group ($P < 0.05$). Prolonged exercise leads to a progressive water and electrolyte loss from the body as sweat is secreted to promote heat loss.

From our findings, exercising footballers have a reduction in serum sodium concentration 2hs after exercising compared with pre exercise condition. The serum sodium however, normalized 2 hours after the exercise. The reduction in serum sodium level during exercise can be attributed to the loss of sodium in sweat during exercise. This is in accordance with the finding of Sanders *et al.* (2001), and Ugwuja *et al* (2014). Though, there is reduction in serum sodium, the reduction was not sufficient to cause hyponatremia. Speedy *et al.* (2001) and Noakes (2002), have observed cases of hyponatraemia during endurance exercise in heat. Also, Ri (2006) highlighted the importance of sodium in fluid homeostasis and advised that persons engaging in long distance exercise should drink as much fluid as possible to prevent dehydration and hyponatraemia. Also observed in our study is a significant reduction in serum chloride. This is however not surprising as both sodium and chloride is the main constituent of sweat in form of salt. Potassium is mostly an intracellular mineral which, interacts with sodium via action potentials in conduction of nerve impulses. Our findings showed a reduction in serum potassium and this could be due to the fact that the exercise duration with sweating and lasted for forty five minutes. It is also expected that if the exercise is prolonged without taking any fluid with increased breakdown of glycogen to supply energy for the body the muscle cells will be depleted of potassium resulting in increase in serum potassium concentration.

Similarly serum bicarbonate concentration changes in our research showed a little decrease. This is not far from the fact that during the exercise period, there may be exercise induced tachycardia. This is also in consonance

with Rojas et al. (2006). Serum potassium is not left out in the alteration in serum electrolyte changes associated with exercise.

Table 1: Mean serum levels of serum electrolytes, urea and creatinine

Groups	Na K ⁺ (mmol/L)	(mmol/L)	Cl ⁻ (mmol/L) (mmol/L)	HCO ₃ ⁻	Urea Creati (μmol/L)	(mmol/L)	Ca ²⁺ (mmol/L)
Pre exercise (A)	144.21 ± 2.88 ± 0.30	3.27	102.37 ± 2.58 ± 1.45	23.28	3.03 ± 74.50 ± 10.09	0.69	3.8 ± 0.41
5 mins after exercise (B)	140.84 ± 3.15 ± 0.431	1.53	100.1 ± 21.87 ± 1.80	22.22	4.10 ± 75.15 ± 7.20	0.74	4.5 ± 0.52
2hrs after exercise (C)	142.89 ± 2.02	3.45 ± 0.23	101.1 ± 3.67 ± 0.74	21.72 ± 4.5	1.60 ± 0.84 ± 0.16	0.12 ± 9.20	3.9 ± 0.31
P value	1.01	0.930		0.921		0.13	0.01
POST Hoc							
A/B	1.00	0.78	1.00	0.67	0.83	0.73	0.04
A/C	0.98	0.97	0.94	0.83	0.83	0.96	0.01
B/C	1.00	1.00	1.00	0.73	0.34	0.82	0.09

* Significant at p< 0.05

Conclusion

Alteration in serum electrolyte is always a serious problem when their concentration is either too high or low and can cause sudden death. It is therefore very important that those embarking in serious physical exercise especially prolonged one should take as much fluid as possible especially water and electrolyte alteration.

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