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Differences in Haematological and Biochemical Parameters of Athletes and Non-Athletes

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Authors' contributions

This work was carried out in collaboration between all authors. Authors BBA, OAM, MOM, WM and BCI designed the study. Authors BBA, MOM and WM performed the statistical analysis. Authors BBA, OAM, MOM, WM and BCI wrote the protocol. Authors MOM, BBA, WM, EE and IKA wrote the first draft of the manuscript. Authors MOM, WM, EE and IKA managed the analyses of the study. Authors BBA, OAM, WM, BCI and MOM managed the literature searches. All authors read and approved the final manuscript.

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Short Communication

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ABSTRACT

Aims: Researches show that sports participation has its own inherent haematological and biochemical adaptations. Although studies have reported that athletes are at vantage level as compare to non-athletes in physiological parameters, whether it extends to haematological and biochemical parameters at rest has not been reported. This study investigated the differences in some haematological and biochemical parameters between athletes and non-athletes at rest.
Study Design: The study used descriptive cross-sectional design.
Place and Duration of Study: Department of Sports and Exercise Science, between October 2016 and April 2017.

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Methodology: Five milliliters blood samples of 23 university students [Mean age = 21.35 ± 2.04 years, 11 athletes (mean age = 21.45 ± 2.46 years), 12 non-athletes (mean age = 21.25 ± 1.66 years)] were collected (within 8-10 hours post prandial) and after at least 24 hours of last sports participation/practice. Blood samples were run for haematological and biochemical analysis.
Results: Differences in red blood cell (P = 0.782), haemoglobin, (P = 0.797), haematocrit (P = 0.655), white blood cell (P = 0.249), lymphocytes (P = 0.740), neutrophil (P = 0.104), platelets (P = 0.372), platelet crit (P = 0.226), mean platelet volume (P = 0.603), urea (P = 0.082), creatinine (P = 0.123), sodium (P =0.488), chloride (P = 0.308) and potassium (P = 0.076) between athletes and non-athletes were not significant.
Conclusion: At rest, athletes and non-athletes had no significant differences in haematological and biochemical parameters. Hence, sports participation should not be solely implicated in the changes associated with haematological and biochemical parameters of individuals.

Keywords: Sports participation; blood cells; urea; creatinine; blood electrolytes; adaptation.

1. INTRODUCTION

Responses to exercise stress involve changes in the haematology and biochemistry of the body. Haematological components (red blood cells, white blood cells and platelets) function mainly in transport, protection and regulation of the various body systems. The rate of production of red blood cells and their survival is highly influenced by sports and exercise participation [1]. Likewise, high stress from sports increases the number of leukocytes in the body [2]. Platelets and platelet related parameters tend to increase also from continuous engagement in sports and exercise trainings [3].

Biochemical responses of the body to a bout of exercise include changes in blood electrolytes, urea and creatinine [4]. Plasma/serum electrolytes are mostly affected by exercise [5]. Elite athletes tend to lose more electrolytes due to their increased sweat rate [6].

Reports have shown that athletes have better physiological adaptations to progressive training than non-athletes [7] and are therefore treated differently. Studies on haematological and biochemical parameters have centered on effects of exercise interventions as well as sports training [8-10]. Differences in haematological and biochemical parameters of both groups have not been explored. Prominently, earlier studies have not hitherto provided information on the haematological and biochemical states of Ghanaian athletes and non-athletes when at rest, hence the need for the study.

2. MATERIALS AND METHODS

2.1 Participants

The study was conducted in the department of Sports and Exercise Science, between October 2016 and April 2017. A descriptive cross-sectional design and twenty-three (23) students of a public university in Kumasi, Ghana, were used. The sample was divided into athlete (males=6, females=5) and non-athlete group (males=5, females=7). The athletes were registered with the university sports directorate, participated in intercollegiate sport competitions for at least five year regularly and competed in the Ghana University Sports Association (GUSA) games for average of two years. The overall average age was 21.35 ± 2.04 years while the mean age of the athletes and non-athletes were 21.45 ± 2.46 years and 21.25 ± 1.66 years respectively.

Participants were included if within the ages of 18 and 30 years, body mass index between 18.5 and 29.9 kg/m^2, active in sporting activity for at least 5 years, non-athletes do not involved in any structured exercise for the same period.

2.2 Data Collection

Body weight and height were measured with KINLee BR-391 super mechanical weighing scale and stadiometer. The ratio of the participants' body weight (kilograms) to a square of height (meters) was used to determine BMI. Blood pressure (BP) and heart rate readings of participants were taken following a standardized protocol [11] and an average of three different readings were recorded.

Five (5) milliliters of blood samples were drawn (between 8-10 hours postprandial) using standard venipuncture procedures [12] from the antecubital vein and dispensed in Ethylenediaminetetraacetic Acid (EDTA) tubes (2 mls) and Serum Separator tubes (3 mls). Athletes' blood examinations were done after at least 24 hours of last sports

participation/practice. The blood samples were transported in an ice-chest within 30 minutes to medical laboratory for analysis. Fully automated Sysmex XP 300 was used to run blood count for red blood cell, haemoglobin, haematocrit, white blood cell, lymphocyte, neutrophil, platelets, mean platelet volume and platelet crit. Blood electrolytes, urea and creatinine levels were also determined using the Kenza Biochemistry Analyzer.

2.3 Statistical Analysis

Statistical Package for Social Sciences (SPSS) version 22.0 was used for data analysis. Independent T-test and Mann-Whitney U were used to compare means of parameters after tested for normality with Shapiro-Wilk test. Significant differences were set at 0.05.

2.4 Ethical Consideration

Ethical approval was obtained from the Committee of Human Research, Publications and Ethics at the School of Medical Sciences, Kwame Nkrumah University of Science and Technology with reference number CHRPE/AP/292/17, after all necessary requirements had been provided.

3. RESULTS

Table 1 shows no significant difference between BMI of athlete and non-athlete (p=0.833) although, the former had lesser BMI (22.46±2.96 kg/m^2) than the latter (22.25±1.88 kg/m^2). Conversely, there was significant difference (p=0.041) in resting SBP in the non-athletes (109.13±11.46 mmHg) compared to athletes (119.52±11.40 mmHg) although athletes had better. Differences in DBP was insignificant (p=0.422) but the mean DBP of the athletes was slightly higher (69.99±7.88 mmHg) than non-athletes (67.67±5.59 mmHg). There was significant difference (p=0.00) between heart rate of the athlete (58.05±7.49 bpm) and non-athlete (75.54±10.49 bpm) in favour of athletes.

Table 2 displays no statistically significant difference in all the haematological parameters. All of these parameters but MPV were higher in the non-athletes than the athletes.

Table 3 indicates insignificant difference in urea and creatinine levels between athletes (urea- 4.57±1.25 mmol/L; creatinine- 54.55±11.23 µmol/L) and non-athletes (urea- 3.54±1.44 mmol/L; creatinine- 46.92±11.49 µmol/L). There was higher

Table 1. Physiological variables of participants

Variables	Non-Athletes Mean ± SD	Athletes Mean ± SD	P value
BMI (kg/m^2)	22.46 ± 2.96	22.25 ± 1.88	.806
SBP (mmHg)	109.13 ± 11.46	119.52 ± 11.40	.041*
DBP (mmHg)	67.67 ± 5.59	69.99 ± 7.88	.422
HR (bpm)	75.54 ± 10.49	58.05 ± 7.49	.000*

**Difference is significant at P < .05*

BMI- Body Mass Index, SBP- Systolic Blood Pressure, DBP- Diastolic Blood Pressure, RHR- Resting Heart Rate

Table 2. Haematological parameters of participants

Variables	Non-Athletes	Athletes	P-value
	Mean ± SD	Mean ± SD	
RBC (10^6/µL)	4.71 ± 0.63	4.64 ± 0.35	.782
HGB (g/dL)	12.55 ± 1.71	12.38 ± 1.34	.797
HCT (%)	40.93 ± 4.57	40.11 ± 4.00	.655
WBC (x10^3/µL)	5.81 ± 1.24	5.18 ± 1.29	.249
NEUT# (x10^3/µL)	2.48 ± 0.83	2.35 ± 1.02	.740
LYM# (x10^3/µL)	2.66 ± 0.66	2.26 ± 0.45	.104
PLT (x10^3/µL)	260.58 ± 48.35	243.64 ± 39.88	.372
MPV (fL)	10.52 ± 0.52	10.85 ± 0.74	.226
PCT (%)	0.27 ± 0.04	0.26 ± 0.05	.603

RBC=Red Blood Cells, HGB=Haemoglobin, HCT=Haematocrit, WBC=White Blood Cells, NEUT#=Neutrophil Number, LYM#=Lymphocyte number, PLT=Platelets, MPV=Mean Platelet Volume, PCT=Platelet Crit

Table 3. Biochemical parameters of participants

Variables	Non-Athletes	Athletes	P-value
	Mean ± SD	Mean ± SD	
Urea (mmol/L)	3.54 ± 1.44	4.57 ± 1.25	.082
Creatinine (µmol/L)	46.92 ± 11.49	54.55 ± 11.23	.123
Sodium (mmol/L)	140.83 ± 1.90	140.27 ± 1.90	.488
Chloride (mmol/L)	102.08 ± 1.31	101.45 ± 1.57	.308
Potassium (mmol/L)	4.18 ± 0.14	3.95 ± 0.37	.076

concentrations of sodium (140.83±1.90 mmol/L), chloride (102.08±1.31 mmol/L) and potassium (4.18±0.14 mmol/L) ions in non-athletes than athletes (sodium- 140.27±1.90 mmol/L; chloride- 101.45±1.57 mmol/L and potassium- 3.95±0.37 mmol/L).

4. DISCUSSION

This study investigated the differences in some haematological and biochemical parameters between athletes and non-athletes at rest. Results show that athletes had significantly higher systolic blood pressure and insignificantly high diastolic blood pressures than the non-athletes at rest, which reiterates earlier findings [13]. The resting heart rate of the athletes was significantly lower than that of the non-athletes as established by literature [14]. Ritti-Dias et al., [15] postulated that regular physical activities improve BMI, although there was no statistically significant difference between the BMI of the athletes and non-athletes.

RBC, HGB, HCT, WBC, NEUT#, LYM#, PLT and PCT were not significantly higher in non-athletes than athletes. Also MPV was insignificantly higher in athletes than non-athletes. Studies have shown that haematological variables of athletes and non-athletes are affected differently following exercise session or training [2,16,17].

Urea and creatinine levels were higher in the athletes than non-athletes. This finding is in contrast to Banfi and Del Fabbro [18] but supports Warburton et al. [4] whose studies showed lower serum creatinine levels and higher urea levels in resting athletes respectively. Electrolytes were higher in non-athletes than athletes as reported by Godek & Bartolozzi [6] that athletes lose electrolytes and have higher sweat rate than non-athletes.

5. CONCLUSION

This study investigated the differences in some haematological and biochemical parameters between athletes and non-athletes at rest. Studies have placed little emphasis on these parameters at rest as compared to other physiological parameters that has been well reported. Student athletes had better physiological characteristics than the non-athletes at rest. However, there were no statistically significant differences in all haematological and biochemical parameters of the two groups. We suggest that changes in haematological and biochemical parameters when at rest should not be solely associated with sports participation.

CONSENT

All authors declare that written informed consent was obtained from the participants for publication of this study. See details under 2.4. ethical consideration.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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