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Sports Participation, Anthropometric and Physiological Profiles of University Athletes

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Summary: Sports participation has been adjudged to enhance healthy living. This study described anthropometric and physiological (A-P) profiles of university athletes based on types of sports (ToS) and duration (in years) of participation (DoP). One hundred and twenty-nine athletes (69 males, 60 females), aged l5-36, who had played averagely for 5.78±0.29years, from nine games and preparing for Ghana University Sports Association (GUSA) 2014 participated in the study. Ex-post facto research design was adopted. Data on ToS, DoP, age, height, weight, body mass index, waist and hip circumference, body fat and water, blood pressure and heart rate were collected, entered into *SPSS* Data Editor 17.0 and exported to *STATA* 11 where multiple regression analysis and t-test were carried out. ToS has significant effects on anthropometric [$F(_{7,121}) = 2.478$, $p<0.05$] and physiological [$F(_{5,123}) = 5.532$, $p<0.05$] profiles. DoP has significant effects on physiological profiles [$F(_{7,121}) = 5.185$, $p<0.05$] of the athletes. Significant differences existed in age, height, weight, BMI, WHR and SBP ($p<0.05$) based on gender. BMI and HR values were not sufficiently healthy for athletes. Clinical intervention is imperative to determine actual cardiovascular risks of the sample because they might be unfit for national assignment if not properly monitored and trained to be consistent in moderate fitness lifestyles.

Keywords*:* Body mass index; Waist-to- hip ratio; Body fat; Body water; Blood pressure; Heart rate

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INTRODUCTION

Sports participation has always been associated with changes in body systems (Bangsbo et al., 2006). Change in physical appearances is usually noticed after some years of sports participation (Allender et al., 2006). These changes form the basis for training and optimal sports performance (Parsons and Betz, 2001) as well as the state of health for the participants (Bonci et al, 2008). Each sport makes various demands on the structure and functions of athletes' bodies. The type of sports (ToS) and duration of play (DoP) are some of the interwoven components that determine changes in body physiology. Training schedules specifically designed for particular sports have physical and physiological requirement for optimum performance (Olawunmi and Ogunleye, 2010). The degree of commitment to training, actual competition and DoP also prelude healthy and athletic feat (Maron and Pelliccia, 2006). While optimal performance may not be major desirable destiny for many university athletes, good state of health is inevitable. A suitable physique is considered prerequisites for good performance in sports (O'Connor et al, 2007). Appropriate size, shape, body build and composition of athletes are important to success in almost all athletic endeavours and could sometimes be used to determine and qualify physiological characteristics of athletes (Agbonjimi, 1994). BMI is suitable for recognizing trends within sedentary or overweight individuals because there is a smaller margin for errors (Igiri, et al., 2008). Tremendous health benefits such as efficiency of cardiac muscles, decreased risk of coronary heart disease, prevention of excessive weight and obesity, varicose veins, increased hemoglobin and improved cardiorespiratory functional capacity, are accrued to student athletes (Qureshi, 2015). Studies have examined anthropometric and physiological (A-P) characteristics of elite athletes among sports (Da-Cruz-Ferreira, and Ribeiro, 2013; Arazi et al, 2011; Duncan et al., 2006; Jawis et al, 2005; Parsons and Betz, 2001).

Konin and Koike (2008) affirmed that transitioning from university level athletes to professional level requires increased technical skill and understanding of the game. Oftentimes physiological measurements are not considered if an individual can successfully compete at a higher level (Konin and Koike, 2008). However, significant attributes for efficient performance in specific game have been associated with A-P variables like age, height, weight, body mass

index, blood pressure and heart rate of athletes (Da-Cruz-Ferreira and Ribeiro, 2013; O'Connor et al, 2007). Despite over flooding of A-P matters in research, scholarly information on university athletes in Ghana remains unavailable. To contribute to achieving success in sports performance at university level, this study is profiling vital health information about student athletes' A-P characteristics in Ghana. It also presents comparative analysis of A-P based on type of sports (ToS), duration of play (DoP) in years and gender.

MATERIALS AND METHODS

This is an ex-post facto research design study (Barron, 2006). One hundred and twenty-nine (129) Kwame Nkrumah University of Science and Technology (KNUST) athletes (male = 69, 53.5%; female = 60, 46.5%) camped for the 2014 Ghana University Sports Association (GUSA) games participated in the study. Permission of the Head of Sports Directorate and coaches in all the sports as well as written consent of the players obtained. The participants were athletes from nine sports [Football (35, 27.1%), Basketball (13, 10.1%), Volleyball (11, 8.5%), Hockey (27, 20.9%), Athletics (13, 10.1%), Handball (4, 3.1%), Netball (6, 4.7%), Table Tennis (11, 8.5%) and Badminton (9, 7.0%)].

Measurements

Prior discussions on purpose of the study and procedures involved were held with the participants and agreement was reached to assemble at Hale and Hearty center, KNUST, Kumasi, Ghana where anthropometric and physiological profiles were measured.

Anthropometric profiles

Anthropometric profiles of age (yr), height (m), weight (kg), waist and hip circumferences (cm) were assessed to the nearest year, 0.1m, 0.5kg, and 0.5cm respectively. Age of the participants obtained from the university sport council record. Height and body weight were measured with the participants standing bare foot and dressed in short gym clothing using stadiometer (seca 217, Hamburg, Germany). Waist and hip circumferences were assessed with the Png body tape measure. Body mass index (BMI in kg/m) was calculated by dividing weight (kg) with the square of height (m) (Fryar, Gu and Ogden, 2012). Waist-to-hip girth ratio (WHR) computed as abdominal girth (cm) divided by hip girth (cm); waist girth represents the narrowest girth around the natural waist and hip girth reflects the widest girth measured around the buttock (Katch et al., 2011).

Physiological profiles

Physiological profiles were body fat and water, systolic (SBP) and diastolic (DBP) blood pressure as well as heart rate (HR) (Callan et al., 2000; Yoon, 2002; Saad, 2012) measured with aneroid compact sphygmomanometer ce0123 (COD.92310) made in China. Percent body fat and water were measured with TBF-410GS Tanita bioelectrical impedance analyser (BIA) made in Tokyo, Japan, when each of them stepped on the scale in a platform without shoe after inputting weight, height, age and sex. Duration of involvement in competitive sport (DoP) and type of sport (ToS) were obtained via self-reported response from the participants. Measurements took place from 7 to 18 July, 2014.

Statistical Analysis

Data obtained were entered into SPSS Statistics 17.0 Data Editor and exported to STATA 11 where multiple regression and independent t-test analyses were carried out. Statistical significance value of 5% was considered for all analysis.

RESULTS

Descriptive summary of anthropometric and physiological (A-P) profiles of university athletes were presented in table 1. Tables 2-5 showed relative effect of types of sports (ToS) and duration (in years) of participation (DoP) on A-P. Comparison of A-P based on gender is presented in table 6. The participants have DoP range of 1 to 20years (mean: 5.78 ± 0.29years) and age between 15 and 36 (mean: 24.53 ± 0.23years).

Table 1. Descriptive Summary of Participants Profiles

A-P Profiles	Mean ± SD	Skewness
Age (yrs)	24.53± 0.23	0.16
Height (m)	1.61 ± 0.07	0.74
Weight(kg)	66.18 ± 12.75	0.67
BMI(kg/m^2)	25.07 ± 4.42**	0.97
WC (cm)	72.94 ± 12.69	-2.56*
HC (cm)	91.47 ± 13.98	-2.21*
WHR(cm)	0.86 ± 6.26	11.35
Fat (%)	27.72 ± 10.36	0.98
Water (%)	55.13 ± 7.04	-0.14*
SBP(mmHg)	123.20 ± 11.65***	0.11
DBP(mmHg)	76.53 ± 12.89***	0.32
HR (bpm)	74.44 ± 11.32****	0.77

BMI=Body Mass Index, WC=Waist Circumference, HC= Hip Circumference, WHR= Waist-Hip Ratio, SBP=Systolic Blood pressure, DBP= Diastolic Blood Pressure, HR=Heart rate, *Waist, hip and water are negatively skewed. **BMI is within overweight range (CDC). ***BP is within pre-hypertension range (Taplin and Flynn, 2013).****HR indicates below average level (ACSM, 2014)

Table 2. Effect of ToS on Anthropometric Profiles

Model	P	Std. Error	Beta	t	Pvalue
(Constant)	-3.737	8.300		-0.450	0.653
Age	0.216	0.482	0.040	0.448	0.655
Height	6.793	5.082	0.207	1.337	0.184
Weight	-0.024	0.058	-0.117	-0.406	0.686
BMI	-0.102	0.158	-0.174	-0.645	0.520
Waist	-0.014	0.025	-0.078	-0.557	0.578
Hip	0.029	0.021	0.179	1.370	0.173
WHR	-1.507	2.293	-0.065	-0.657	0.512

a. Predictors: (Constant), Age, Height, Weight, BMI, Waist, Hip, WHR b. Dependent Variable: ToS $R=0.354^a$, $R^2=0.125$, Adj $R^2=0.075$, SS =107.874, MS = 15.411, $F_{(7,121)}=2.478$, $P<0.05$

Table 3. Effect of ToS on Physiological Profiles

Model	P	Std. Error	Beta	t	Pvalue
(Constant)	4.961	3.598		1.379	0.170
Fat	-0.066	0.021	-0.266	-3.146	0.002*
Water	0.006	0.031	0.015	0.183	0.855
SBP	-0.035	0.018	-0.157	-1.886	0.062
DBP	0.057	0.017	0.284	3.332	0.001*
HR	0.005	0.019	0.023	0.281	0.779

a. Predictors: (Constant), HR, Water, Fat, SBP, DBP b. Dependent Variable: ToS $R=0.428^a$, $R^2=0.184$, Adj $R^2=0.150$, SS =157.989, MS = 31.598, $F_{(5,123)}=5.532$, $p<0.05$ *Significant at p<005

Table 4. Effect of DoP in sports on Anthropometric Profiles

Model	P	Std. Error	Beta	t	Pvalue
(Constant)	-9.356	8.879		-1.054	0.294
Age	2.489	0.516	0.400	4.823	0.000*
Height	6.011	5.437	0.161	1.106	0.271
Weight	0.023	0.063	0.099	0.366	0.715
BMI	-0.059	0.169	-0.089	-0.352	0.726
Waist	-0.011	0.027	-0.054	-0.409	0.683
Hip	0.020	0.022	0.108	0.882	0.379
WHR	-0.589	2.453	-0.022	-0.240	0.811

a. Predictors: (Constant), WHR, Age, Hip, Height, BMI, Waist, Weight b. Dependent Variable: DoP $R=0.480^a$, $R^2=0.231$, Adj $R^2=0.186$, SS =358.330, MS = 36.904, $F_{(7,121)}=5.182$, $P<0.05$

Table 5. Effect of DoP in sports on Physiological Profiles

Model	P	Std. Error	Beta	t	Pvalue
(Constant)	4.873	4.534		1.075	0.285
Fat	0.015	0.027	0.054	0.581	0.562
Water	0.006	0.038	0.015	0.161	0.872
SBP	0.000	0.023	-0.002	-0.017	0.987
DBP	0.003	0.022	0.012	0.124	0.902
HR	-0.002	0.024	-0.008	-0.088	0.930

a. Predictors: (Constant), WHR, Age, Hip, Height, BMI, Waist, Weight b. Dependent Variable: DoP $R=0.058^a$, $R^2=0.003$, Adj $R^2=-0.037$, SS =3.722, MS = 0.744, $F_{(5,123)}=0.082$, $P>0.05$

Table 6: T-test Gender Comparison of A-P Profiles

A-P Profiles	Gender	Mean±SD	F	P-value	t	Mean Difference
Age	Male	23.00 ± 0.45	9.451	0.003	2.430	0.20*
	Female	17.80 ± 0.48			2.421	
Height	Male	1.64 ± 0.07	6.943	0.009	6.071	0.07*
	Female	1.57 ± 0.06			6.174	
Weight	Male	59.70 ± 11.69	0.063	0.002	6.093	12.11*
	Female	71.81 ± 10.87			6.062	
BMI	Male	23.84 ± 4.33	0.070	0.007	3.033	2.30*
	Female	26.14 ± 4.25			3.038	
Waist	Male	71.81 ± 15.93	1.313	0.254	-.503	-1.27
	Female	73.08 ± 12.07			-.513	
Hip	Male	88.26 ± 16.83	1.936	0.167	-1.955	-5.51
	Female	93.76 ± 14.87			-1.972	
WHR	Male	0.83 ± 0.10	0.513	0.014	3.648	0.07*
	Female	0.76 ± 0.10			3.632	
Fat	Male	26.66 ± 10.45	0.395	0.531	-1.249	-2.28
	Female	28.94 ± 10.21			-1.251	
Water	Male	55.85 ± 6.62	0.148	0.701	1.248	1.55
	Female	54.31 ± 7.46			1.238	
SBP	Male	128.43 ± 11.36	5.040	0.026	6.223	11.25*
	Female	117.18 ± 8.77			6.335	
DBP	Male	75.31 ± 12.36	1.118	0.292	-1.150	-2.61
	Female	77.93 ± 13.45			-1.143	
HR	Male	73.17 ± 11.58	0.001	0.981	-1.377	-2.74
	Female	75.91 ± 10.92			-1.383	

No = (Male 69, Female 60) *Significant difference between male and female athletes in A-P ($p<0.05$)

DISCUSSION

This study described anthropometric and physiological (A-P) profiles of university athletes and examined the effects of ToS and DoP on the profiles. Preference was also given to gender differences in A-P variables. The average age (24.53 ± 0.23 years, table 1) obtained in this study seems to be on the high side for highly vigorous sports peculiar to Africa as the ability to endure aerobically for long will be low. It may place participants, although young adults (Petry, 2002; Rakowski et al, 1990) at disadvantage to compete regularly for long if given shirt in the national team. It may also prone the athletes to potential health/injury risks (Uijtdewilligen et al, 2014; Suliburska et al, 2012) even as athletes. It means that most of the athletes may retire early. This may also account for their inability to win the tournament they were preparing for as reflected in the significant effect of DoP (table 4).

The participants' average height (1.61±0.07m, table 1) falls within those found in earlier studies (Igiri et al, 2008; Ransone and Hughes, 2004). As athletes, stamina is an asset to good performance. The average weight of 66.18kg (table 1) in this study was less than 95.25kg expected in a cluster of sports (Manfred, 2014). Literature acknowledged importance of body weight to health and athletic performance that it should be assessed frequently because of increased risk of dehydration and heat-related illness (Turocy et al, 2011). Monitoring of body weight has responsibility of attenuating body mass index to ensure required sustainable lean body mass for health (Suliburska et al, 2012; Ransone and Hughes, 2004). There was significance difference in body weight based on gender (table 6) where female athletes have higher value. This finding may be associated with eating disorders as documented by Milligan and Pritchard (2006) in the study of Johnson, Powers and Dick that out of 1445 Division 1 college athletes, 9% of the female athletes needed treatment for their eating disorders with additional 58% that were at high risk for developing eating disorder behaviours.

The average BMI of 25.07±4.42 kg/m^2 (table 1) obtained was on the high side (overweight) not only for athletes but also for general good health (CDC; Konin and Koike, 2008). Although, there was significant effect of ToS and DoP on the general anthropometric profiles of the participants, there was no significant effect specifically on BMI (table 2 & 4) which may reflect their level of commitment during and to training activities. Gender comparison of BMI

shows significant difference in favour of male (table 6). Despite the finding on BMI, the value of average WHR (0.86cm) in table 1 appears to be within a healthy range of university athletes (Karimfar et al., 2013). The average body fat value (27.72 ± 10.36%, table 1) in the study sample was not only above the expected range in general population but also above that of athletic population (Jeukendrup and Gleeson, 2010) without significant difference in gender (table 6). This value is considered health risk and detrimental to good athletic performance. The average body water (55.13 ±7.04%) for the study sample was just optimal for resting normal individuals but rather less than expected amount for athletes. Study has shown that more than 2 or 3% dehydration of body mass can potentially compromise or disturb physiological function, increase athletes' risk of developing heat cramps, heat exhaustion or heat stroke and influence sports performance negatively (Turocy et al, 2011; ACSM, 2014). This value may be accounted for by the relatively high body fat in the subjects studied.

For athletes to perform optimally, a lower resting blood pressure of 115/75mmHg has been recommended (Hellesvig-Gaskell, 2013). Our study population has an average resting blood pressure of 123/76mHg which is above the recommended average. Gender comparison in table 6 shows significant difference ($p<0.05$) with male having higher systolic blood pressure. This suggests that athletic performance will be suboptimal as blood pressure tends to increase during exercise. This increase will put stress on cardiac efficiency and therefore limit maximal athletic performance aerobically (Bangsbo et al., 2010). Likewise, the observed average resting heart rate value of 74.44±11.32bpm was seen to be high for good athletic performance since studies have shown that a well trained athlete can have normal resting heart rate closer to 40bpm (Baggish and Wood, 2011; Laskowski, 2012). Based on ToS and DoP in tables 3 and 5, the mean heart rate for the group was not significant ($p>0.05$). On the basis of general health and wellbeing, the resting heart rate value was below average in the age range chart (Ostchega et al., 2011) which indicates sedentary. The sample studied need to work on their weight to reduce BMI, body fat, WHR and resting heart rate.

Sports participation fails to yield expected wellness in the population studied. Findings present these student athletes as having inactive health condition when participation in sports uphold major determinant of vigorous active healthy lifestyle. More clinically inclined interventional studies using this population with attention on the observed variables will vividly complement the findings of this study. A comprehensive educational and clinically inclined intervention is imperative to determine the actual state of physiological profiles of university athletes across sports and duration of participation.

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