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Differences in Physical, Physiological and Motor Performance Traits between Volleyball and Basketball Athletes in a University in Ghana

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Summary: Physical, physiological and motor performance traits play substantial role in both volleyball (VB) and basketball (BB) competitions. The differences in these traits among University athletes in Ghana have not been reported. Hence, this study documents and compares the physical, physiological and motor performance traits of VB and BB university athletes. Purposive sampling technique involving thirty-five university athletes (24 males and 11 females) with mean age of 21.77 ± 2.03years was used. Height, weightn, waist and hip circumferences, waist to hip ratio (WHR), body mass index (BMI), heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP), shoulder muscular endurance (SME), abdominal muscular endurance (AME), left and right Arm Strength, Leg Power, Reaction time, Agility and Speed traits were measured. Descriptive statistics was used while analysis of variable was by paired t-test and significance was at $p<0.05$. Volleyball players significantly have better WHR, AMS and agility while Basketball athletes possess better SBP, SME and reaction time. Gender influence was significant in height, WHR, HR, SBP, SME, AME, LAS, RAS, speed, reaction time, power and agility. Athletes in both games do not have similar physical, physiological and motor performance traits. Volley Ball players had better abdominal muscular endurance, right-hand muscular strength, speed, power and agility while BB players had better shoulder muscular endurance and reaction time traits. These differences in traits should inform volleyball and basketball coaches in their selection.

Keywords*:* Motor performance, University athletes, Blood pressure, Heart rate

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INTRODUCTION

Optimal athletic performance in ball games, including Volleyball (VB) and Basketball (BB), requires complexity of proficiency in multifaceted components such as physical, physiological, mental and tactical traits. Both scientific and sporting communities have recognized the importance of genetic factors in athletic performance (Kom and Roth, 2013). Physical and physiological traits of individual players play important roles on the skills and tactics of a VB or BB team (Nikolaidis et al., 2015). These games are among the world's popular games played practically in every nation at varying levels of competence (Gaurav, Singh and Singh, 2010). The level of competence of players in both games depends on their upper extremity power and hand grip strength. Each game has unique physical requirements which are dramatically different (Guth et al, 2013). However, VB and BB athletes often interchangeably participate in competitions that require optimal performance as they share some common factors. In essence, strategy for effectiveness in each requires specifically different body morphology (i.e., height, body size and composition) with specific cardiovascular (blood pressure) and respiratory (heart rate) fitness (Lorenz et al, 2013). Beyond the aforementioned, muscular strength and endurance, power, speed, agility and reaction time are primary factors underlying performance in both games (Zaccagni et al, 2014).

Poor athletic performance has been associated with injury occurrence, depression, varying diets, sleeping patterns; and lack of periodic scientific assessment, well-structured warm-up session, self-actualisation and base line data (Kimberly, 2013; Melorose et al, 2015). In as much as a single study could not address the aforementioned, a co-ordinated approach to solve each of these pertinent components would enhance athletic development. Since athletes' baseline data (physical, physiological and motor performance) have a crucial role for further developmental programmes, this study identified and comparatively documented the physical, physiological and motor performance traits in VB and BB athletes in a university in Ghana.

MATERIALS AND METHODS

Subjects

The study adopted a cross-sectional research design. Thirty-five university athletes with mean age of 21.74 ± 2.24 years, height of 1.78 ± 0.09 meters, weight of 74.44 ± 10.53 kg, 24 males (basketball = 14, volleyball = 10) and 11 females (basketball = 10, volleyball = 1) voluntarily participated in the study.

Exclusion criteria

The exclusion criteria for the study entailed no record of registration with KNUST Sports Directorate, exclusion from the list of athletes submitted to represent KNUST in the twenty fourth Ghana University Student Association (GUSA) games, held at the University College of Education, Winneba, Ghana in 2016, any sign of foot pain, back pain, evidence of cardiorespiratory and musculoskeletal disease for less than six months before the study. Participants signed a consent form after the KNUST Sports Directorate approved the study.

Measurements

Assessments were carried out at the main KNUST sports complex. All measurements were completed in a standardised format, described by Nieman (2011), during the two weeks camping for GUSA games. Readings were early morning before training sessions. Age in year was recorded from students' registration file due to reluctance in giving exact age.

Physical Traits

Height in meters and weight in kilogram were measure with Health-O-Meter (HY-RGZ160 Weight & height measuring scale, China). Body Mass Index (kg/m^2) was measured with the index of weight adjusted for height square. A non-elastic tape was used to measure waist circumference at the smallest body (natural waist) width between ribs and hips after normal inhalation, and hips circumference at the largest site of the buttocks in accordance with Ruiz et al (2009)'s protocol for determination of Waist to Hip Ratio (WHR).

Physiological Traits

Hand-held sphygmomanometer with stethoscope (P-130, CA.MI Italian Medical Touch) was used to measure blood pressure and heart rate.

Motor Performance

Shoulder muscular endurance was measured using the non-modified 90° push-up to an elbow angle of 90° protocol without gender bias while sit-up was used for abdominal muscular endurance as recommended (Childs et al., 2009). Left-hand and right-hand muscular strength were measured with the Lafayette hand grip dynamometer (model 78010, USA). To determine the participants' speed, they were made to optimally run a distance of 30 meter demarcated on the 100 meter-distance of a standard 400 meters synthetic track. The participants' reaction time was measured using a-30 centimeter long ruler according to a standardised protocol (Eby et al, 2007) while Power in Watts was determined through vertical jump test as described by Abidin and Adam (2013). Illinois agility test was conducted to measure agility of participants (Abass et al., 2011). Casio (HS-80TW-1, India) stopwatches were used for all timing recorded to nearest seconds.

Statistical Analysis

Statistical analyses were carried out using SPSS 23.0 program for Windows (SPSS, Inc, Chicago, IL, USA). Descriptive statistics were generated and paired t-test was conducted for all variables. Significance level was set at $p<0.05$ in the study.

RESULTS

The physical, physiological and motor performance traits of the participants are shown in table 1. The student-athletes sampled in this study aged between 17 to 28 years with average age of 21.74 ± 2.24 years. The value of BMI combined with that of WHR predicts low cardiovascular risk (Neiman, 2011). The values of physiological components indicate that the participants were fit with mean heart rate of 59.85 ± 9.38bpm and blood pressure of 123.00 ± 12.63/72.62.9.28mmHg. The participants were able to contract their shoulder muscles repeatedly over an extended period of time moderately. The muscular

Table 1: Summary of Participants' Physical, Physiological and Motor Performance Traits

Traits		Mean±SD
Physical	Age (yr)	21.74±2.24
	Height (m)	1.78±.09
	Weight (kg)	74.44±10.53
	BMI (kg/m^2)	23.36±2.92
	WC (cm)	72.14±14.02
	HC (cm)	92.61±18.06
	WHR (%)	0.77±0.05
Physiological	RHR (bpm)	59.85±9.38
	SBP (mmHg)	123.00±12.63
	DBP (mmHg)	72.62±9.28
Motor Performance	SME(rep.)	26.48±11.87
	AME(rep.)	34.90±7.81
	LMS(kg)	53.95±26.90
	RMS(kg)	47.67±21.01
	Speed(sec.)	0.51±0.16
	Reaction time (cm)	8.96±3.26
	Power (Watt)	518.11±84.10
	Agility (sec.)	11.55±7.02

Keys*: BMI- Body Mass Index, WC- Waist Circumference, HC- Hip Circumference, WHR- Waist-hip Ratio, RHR-Resting Heart Rate, SBP - Systolic Blood Pressure, DBP-Diastolic Blood Pressure, SME-Shoulder Muscular Endurance, AME-Abdominal Muscular Endurance, LMS-Left-hand Muscular Strength, RMS- Right-hand Muscular Strength*

Table 2: Differences in Physical, Physiological and Motor Performance Traits by Sport Types

Traits		Volleyball (Mean±SD)	Basketball (Mean±SD)	P-value
Physical	Age (yr)	22.10 ± 2.28	21.60 ± 2.25	.559
	Weight (kg)	70.77 ± 10.74	75.59 ± 10.55	.233
	Height (m)	1.85 ± 5.67	1.83 ± 37.15	.617
	BMI (kg/m^2)	22.58 ± 3.33	23.65 ± 2.77	.335
	WC (cm)	76.00 ± 7.51	70.60 ± 15.77	.311
	HC (cm)	93.50 ± 5.48	92.26 ± 21.22	.858
	WHR (%)	0.81 ± 0.05	0.76 ± 0.04	.022*
Physiological	RHR (bpm)	57.85 ± 9.95	60.50 ± 9.98	.547
	SBP (mmHg)	129.85 ± 10.49	120.31 ± 14.22	049*
	DBP (mmHg)	77.57 ± 9.94	71.00 ± 9.97	.140
Motor Performance	SME(rep.)	25.50 ± 8.99	29.96 ± 15.54	.032*
	AME (rep.)	40.60 ± 5.66	34.00 ± 15.01	.037*
	LMS(kg)	46.00 ± 15.01	47.68 ± 23.98	.839
	RMS(kg)	51.10 ± 27.58	49.72 ± 27.71	.895
	Speed (sec.)	44.20 ± 3.70	47.28 ± 11.77	.426
	Reaction time (cm)	11.20 ± 2.82	9.16 ± 3.89	.043*
	Power (Watt)	179.70 ± 85.24	161.96 ± 88.61	.592.
	Agility (sec.)	3.15 ± 0.01	15.97 ± 1.27	.000*

*Significance observed at $P < 0.05$

Table 3: Gender Differences in Physical, Physiological and Motor Performance Traits

Traits		Male (Mean±SD)	Female (Mean±SD)	P-value
Physical	Age (yr)	22.37 ± 1.76	20.36 ± 2.61	.011*
	Weight (kg)	75.81 ± 10.10	71.45 ± 11.31	.262
	Height (m)	1.82 ± 0.07	1.69 ± 0.08	.000*
	BMI (kg/m^2)	22.73 ± 2.68	24.73 ± 3.10	.060
	WC (cm)	72.00 ± 13.55	72.45 ± 15.69	.931
	HC (cm)	89.77 ± 15.74	98.81 ± 21.83	.172
	WHR (%)	0.79 ± 0.04	0.73 ± 0.05	.000*
Physiological	RHR (bpm)	57.50 ± 9.76	65.00 ± 6.16	.026*
	SBP (mmHg)	127. 20 ± 10.51	113.81 ± 12.39	.002*
	DBP (mmHg)	73.08 ± 9.63	71.63 ± 8.84	.675
Motor Performance	SME(rep.)	31.58 ± 10.49	15.36 ± 5.25	.000*
	AME (rep.)	37.90 ± 6.41	28.36 ± 6.64	.000*
	LMS(kg)	65.16 ± 24.20	29.50 ± 12.40	.000*
	RMS(kg)	57.31 ± 17.41	26.63 ± 9.69	.000*
	Speed (sec.)	0.47 ± 0.14	0.59 ± 0.17	.044*
	Reaction time (cm)	8.16 ± 2.48	10.72 ± 4.12	.028*
	Power (Watt)	671.04 ± 313.32	184.45 ± 87.164	.046*
	Agility (sec.)	9.16 ± 7.32	16.77 ± 0.85	.002*

*Significance observed at $P < 0.05$

contraction of the left- and right-hands of the athletes was good. The mean time returned by the athletes in 30meter dash was below average. The elapsed time between the presentation of a sensory stimulus and subsequent behavioural response of the athletes was good. Mean power in Watts was below average and rate of maneuverability skill amount to 11.55 ± 7.02secs.

Table 2 revealed paired t-test analysis on physical, physiological and motor performance between VB and BB players. VB players have better BMI, WC, HC, WHR, RHR, AME, agility, speed and power. BB players on the other hand have better weight, SBP, DBP, SME, LMS, RMS and reaction time. Significant differences exist between WHR (mean ± SD = 0.81 ± .05 > 76 ± .04), SBP (mean ± SD = 129.85 ± 10.49 > 120.31 ± 14.22), SME (mean ± SD =25.50 ± 8.99 < 29.96 ± 15.54), AME (mean ± SD = 40.60 ± 5.66 > 34.00 ± 7.12), Reaction time (mean ± SD = 11.20 ± 2.82 > 9.16 ± 3.89) and agility (mean ± SD = 3.15 ± 0.01 < 15.97 ± 1.27). Gender comparison reported in table 3 showed differences in all measured variables ($P < 0.05$) with the exception of weight, BMI, waist and hip circumferences and DBP ($P > 0.05$).

DISCUSSION

The present study compares physical, physiological and motor performance traits of VB and BB athletes in a university in Ghana. VB and BB athletes in this study have normal physical and physiological traits; and below average motor performance. The weight of athletes who play BB is more than that of VB. This

supports earlier submission that BB players have better, stronger base of support and balance of equilibrium than VB players (Roscoe, 2009). This reiterates that VB athletes do not have good stability for maximal performance in the position of shooting and point guards in the game of BB as reported (Vanderlei et al., 2013). This finding supports earlier studies that reported BB players to be heavier with greater muscle mass than players of other sports (Impellizzeri et al., 2008, Chrisman et al., 2012). VB players were however taller than the athletes playing BB. Based on height, VB athletes could effectively function as centers in BB because height is one of the vital traits of a center in BB game (Gaurav et al., 2010). Studies have reported that height and weight play major role in both games with reference to position and patterns of play (Lara Araújo et al., 2013; Sattler et al, 2015)

We observed differences also in BMI which could be associated with the variance in body mass which favoured VB players. Athletes in VB game have better WHR than BB although they both have low heath risk WHR values (de Koning et al, 2007; Huxley et al, 2009). VB players have better heart rate compared to BB players. This could be explained through the improvement seen in respiratory functioning as a result of workload (Hofmann and Pokan, 2010). A rather contrasting finding was observed in BB players with normal blood pressure as against the high value for their VB counterparts with low heart rate at rest. Although it is medically evident that low heart rate at rest indicates good respiratory fitness but when blood is high, it could indicate stress level, medication effect and insufficient flow of blood to the brain (Bouzat et al, 2013) of the athletes in the game of VB.

Results of this study also showed that VB players have dominant abdominal muscular endurance, right-hand muscular strength, speed, power and agility traits which negate the finding of Silva et al (2013) who reported that adolescents who played BB had better performance in explosive power than those who played other sports. The dominance of players in the game of BB only reflected in shoulder muscular endurance and reaction time traits with marginal difference in left-hand muscular strength. This supports earlier work on male handball players between 15-25 years that abilities to perceive the meaning of a stimulus, react correctly and move to the required direction immediately are vital in BB (Gavkare et al, 2011).

Significant gender differences were observed in all the measured variables with the exception of weight, BMI, waist and hip circumferences and DBP in this study. Level of fitness of work output of males could account for the differences as most studies revealed male dominance over female in athletic performance (Abidin and Adam, 2013; Elendu and Okanezi, 2013). This study showed that optimal performance in VB and BB games is a function of multidimensional mechanisms peculiar to individual systemic differences, game situation and position of play.

Conclusion

This study revealed that VB players have better abdominal muscular endurance, right-hand muscular strength, speed, power and agility while BB players dominate in shoulder muscular endurance and reaction time traits. For these reasons, it might not be advisable to interchange players for both games without noting these differences, hence, volleyball and basketball coaches should note these differences during selection.

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