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# Analogical and Diversification of Anthropometric and Motor Performance Characteristics among Female Universities Soccer Players in Ghana

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**Abstract** There are uneven academic sports policies and sociocultural diversities in Ghana. While academic sports policies and sociocultural diversities often call for acclimatization of athletes, scarce research on the analogical and diversification anthropometric and motor performance characteristics restricts decision-making policy on female soccer participation. This study presents the analogical and diversifications of the anthropometric and motor performance characteristics among the university female soccer athletes. The cross-sectional study had 44 female athletes from topmost universities with mean age of 21.54±1.79 years and playing experience of 6.75±1.51 years. Leg length, thigh girth, calf girth, upper arm length, forearm length, upper arm girth, chest girth, finger span, speed, leg power, abdominal strength, agility, flexibility, upper body strength, distant kick, dribbling, and accuracy were measured, compared among institutions, and with international normative values (INV). There was no significant difference in all characteristics except abdominal strength ($P$ = .000), distant kick ($P$ = .009), thigh girth ($P$ = .003), and calf girth ($P$ = .002). When compared to INV, there was significant difference in all characteristics except the upper arm length ($p$= .587), forearm length ($p$= .734), and agility ($p$= .479). This study suggests that female soccer players in all the topmost universities in Ghana are equally good sports potentials for national recruitment.

**Keywords** Thigh Girth, Calf Girth, Upper Arm and Forearm Length, Speed, Leg Power, Abdominal Strength, Distant Kick, Dribbling

## 1. Introduction

The transformation in female sports has transient the era when higher competitive levels of sports participation were solely associated to boys and men. In the present dispensation, female athletes compete continuously at very high levels as well as their men counterparts in all sports including football [1]. Study on the challenges of female soccer has mainly centered on explaining the volume, intensity, and activity patterns of players [2]. The active involvement of females in soccer as a contact game with high intensity and intermittent sprint has attracted studies in the developed countries [3–5]. The outcomes of scientific studies in developed countries have also been translated into the enrolment of female into various soccer

academies for grooming [6,7]. Most of the female soccer players in these sports academies are transformed into professional elites who also represent their countries internationally.

Development of female soccer players in African has [8] witnessed little advancements. Recent study on the anthropometric and physical fitness profiles of Tunisian female soccer players bemoaned the 'lack of descriptive data on the characteristics of female soccer players from the African continent' [8]. Earlier studies about male soccer players in Ghana universities presented that soccer is only used as co-curricular endeavour, an essential part of overall education and a widespread tool to develop students for future goals [9,10].

Ghana tertiary institutions compete in intramural competitions (among hostels and faculties), and extramural competitions including GUSA (Ghana University Sports Association) games, WAUG (West Africa University Games), FASU (Federation of Africa University Sports) games as well as FISU (International University Sports Federation) games [10]. Although these competitions support female participation with the outstanding athletes getting national invitation, sociocultural and lack of standard and general sports policies in Ghanaian higher institutions often pose challenges to their participation in Ghana.

Fitness characteristics like body composition, muscular strength and endurance, speed, agility, skill levels, and coordination are basic on which more complex skills are laid generally in both male and female [8,11,12]. In soccer female players specifically, more complex attributes such as kicking accuracy and velocity [13], seasonal changes in physical performance and physical characteristics [11,14], biomechanical changes[15] as well as psychological traits [16] have recently been studied.

Although outcomes of such empirical studies have been essential to the development of progress and proactive female sports policies in higher institution in advanced countries, it is, however, a major concern that there are scarce scientific data about physical fitness parameters such as anthropometric as well motor performance of female soccer players in Ghana universities as compared to their male counterparts maybe because of weaknesses in the female's game in contrasted with the male's game as established [17]. There has been suggestion about the similarity in directional changes of male and female soccer players with equal matching in attempt to act and react to swerving attack and defensive movement[18]. Female soccer players have equally been reported to possess good on field motion and correct placement on the pitch when either attacking or defending [19,20]. This could suggest the reason for minor injuries from over-stretched muscles. Female soccer players during competitions. In addition, improvement of female soccer skills is associated with the understanding of the corresponding fitness profile possessed by athletes for the level of play [21].

Despite the scientific acknowledgement of the need for coaches (including university soccer coaches) to be abreast with the physiological and physical characteristics of athlete as prerequisites for designing appropriate training programmes, scarce research on the analogical and diversifications anthropometric and motor performance characteristics restricts decision-making policy and training specific programmes on female competitions.

# 2. Materials and Methods

### 2.1. Study Design

Comprehensive narrative of the materials and methods used in this study has been published [8,10,22]. The research design employed was the cross-sectional descriptive which helped to assess the characteristics of the participants in terms of anthropometric and motor performances. This type of research design is usually used to estimate the prevalence of the outcome of interest for a given population, many outcomes and risk factors can be assessed, useful for understanding disease aetiology, and for the generation of hypotheses where there will be no loss to follow-up generally for planning public health issues [23-25].

### 2.2. Participants

There were forty-four (44) universities in Ghana out of which four always stand top. The starting eleven (11) players of the female soccer teams in each of the four foremost traditional universities (Teams 'A', 'B', 'C', and 'D') from different geographic locations of Ghana were recruited for the study. The playing positions of the female soccer players were two attackers, four midfielders, four defenders (two laterals and one central), and one goalkeeper given a total of forty-four. The study obtained permission from the Institutional Review Board (IRB) of the University of Cape Coast (UCCIRB/CES/2015/03). There were discussions between the participants and authors on the confidentiality of information obtained prior the commencement of the tests. Participants were given instructions and adequate demonstrations on the measurement processes were made prior to the beginning of the tests. The nature, purpose, and expected outcomes during and after the administration of the tests were also explained to all participants. All the participants who showed interest signed informed consent forms.

### 2.3. Protocol and Measurements

Anthropometric characteristics measured were height (stature), weight, leg length (full), mid-thigh girth, calf

girth, upper arm length, forearm length, upper arm girth, chest girth, and finger span. Height of the participants was measured with stadiometer height and weight (SKU: KC-3001). Body weight was recorded with participants on gym cloth, without shoes or heavy accessories with the use of Omron body composition analyzer (Omron BF511 body composition analyzer) placed firmly on even floor. Body mass index (BMI) value obtained from the body composition analyzer was recorded and analysed in (kg)/ height-2 (m-2). Waist circumference was measured between the lower margin of the least obvious rib and the top of the iliac crest at the midpoint while hip circumference was measured around the widest potion of the buttocks of the participants with nonelastic tape measure (Hawk Importers TM1701). The ratio of waist circumference over hip circumference resulted in waist-to-hip ratio. On motor performance, speed (36.58m dash), leg power (vertical jumps), kicking ability (distant kick, dribbling and accuracy), upper body strength (push-ups), agility (Illinois run), abdominal strength (sit ups), and flexibility test (sit and reach test) were measured.

### 2.4. Statistical Analysis

IBM SPSS Statistics Data Editor version 20 was used to analyze the data collected. Descriptive as well as inferential statistics were used to analyze the data obtained for this study. One way analysis of variance (ANOVA) with post hoc and multiple regression was employed to analyze the differences among the institutions. Sample t-test statistics were analysed for the differences between anthropometric, motor performance and kicking ability of female soccer players and international university female soccer players. The alpha level was set at 0.05.

## 3. Results

Table 1 is an exhibition of the means, standard deviations (SD) and ranges of the ages of university female soccer players in Ghana. These values suggest that the female soccer players in the universities in Ghana are well built.

**Table 1.** Descriptive Characteristics (N= 44)

| Characteristics | Mean ± SD | Range |
|---|---|---|
| Age | 21.54±1.79 | 19.00-26.00 |
| Playing Experience | 6.75±1.51 | 4.00-11.00 |
| Height | 160.53±5.59 | 147.00-175.00 |
| Weight | 57.66±6.12 | 42.40-66.10 |
| Leg length | 79.38±5.06 | 52.00-83.60 |
| Thigh girth | 53.99±4.87 | 46.20-61.00 |
| Calf girth | 37.00±2.81 | 31.20-41.10 |
| Upper arm Length | 33.15±1.52 | 29.30-36.10 |
| Fore Arm Length | 28.83±1.56 | 25.00-30.90 |
| Upper Arm Girth | 27.67±1.59 | 24.90-29.80 |
| Chest Girth | 86.28±3.34 | 80.60-92.40 |
| Finger span | 52.49±2.77 | 45.60-58.40 |
| Speed | 6.15±.40 | 5.65-7.89 |
| Leg Power | 39.63±3.33 | 31.00-47.00 |
| Abdominal Strength | 24.18±2.22 | 19.00-28.00 |
| Agility | 16.92±.71 | 15.88-18.80 |
| Flexibility | 26.14±1.86 | 21.00-29.60 |
| Upper Body Strength | 24.73±3.11 | 16.00-32.00 |
| Distant Kick | 41.23±5.51 | 33.20-51.70 |
| Dribbling | 16.03±.92 | 14.54-18.11 |
| Accuracy | 4.05±1.20 | 1.00-5.00 |

**Table 2.** Comparison of Motor Performance and Anthropometric Characteristics among institutions

| Characteristics | Institutions (N= 44) | | | | *F* | *P* |
|---|---|---|---|---|---|---|
| | ***Team A*** | ***Team B*** | ***Team C*** | ***Team D*** | | |
| Height (cm) | 159.03 ±8.76 | 159.12 ±3.36 | 161.76±5.46 | 162.20±2.64 | 1.002 | .402 |
| Weight (kg) | 55.16 ±7.43 | 56.42 ±5.47 | 57.20 ±6.45 | 61.82±2.47 | 2.790 | .053 |
| Speed(s) | 6.32±.57 | 6.15±.44 | 5.97±.18 | 6.14±.40 | 1.408 | .255 |
| Leg Power (cm) | 38.25±3.95 | 39.65±3.63 | 39.14±1.99 | 41.47±3.00 | 1.954 | .136 |
| Abdominal Strength (reps) | 21.91±1.81 | 24.73±1.68 | 25.82±1.08 | 24.27±2.24 | 9.724 | .000* |
| Agility (s) | 16.94±85 | 17.06±95 | 16.98±58 | 16.71±35 | .475 | .701 |
| Flexibility (cm) | 25.83±2.64 | 25.42±1.68 | 27.07±1.13 | 26.24±1.47 | 1.659 | .191 |
| Distant Kick (m) | 37.07±1.87 | 43.54±4.32 | 40.50±5.35 | 43.81±6.87 | 4.461 | .009* |
| Dribbling (s) | 16.60±95 | 15.78±71 | 15.72±1.04 | 16.03±92 | 2.355 | .086 |
| Accuracy (Pts) | 3.77±1.04 | 4.18±1.11 | 4.43±1.04 | 3.79±1.56 | .744 | .532 |
| Upper Body Strength (rep) | 23.09±3.53 | 25.46±2.66 | 25.09±3.42 | 24.27±2.49 | 1.423 | .250 |
| Leg length (cm) | 78.27±4.00 | 78.02±8.75 | 80.98±3.10 | 80.23±.87 | .904 | .448 |
| Thigh girth (cm) | 50.01±3.10 | 57.22±3.33 | 54.19±5.29 | 54.51±4.90 | 5.353 | .003* |
| Calf girth (cm) | 34.40±1.70 | 38.20±1.84 | 37.25±2.89 | 38.14±2.94 | 6.032 | .002* |
| Upper arm Length (cm) | 32.97±2.32 | 33.40±1.15 | 33.40±1.20 | 32.80±1.19 | .432 | .731 |
| Forearm Length (cm) | 28.86±1.27 | 28.84±1.30 | 29.33±1.33 | 28.94±1.18 | .210 | .889 |
| Upper Arm Girth (cm) | 27.63±1.52 | 27.52±1.80 | 28.07±1.56 | 27.45±1.62 | .317 | .813 |
| Chest Girth (cm) | 86.27±3.23 | 85.44±3.26 | 85.29±3.59 | 88.11±2.88 | 1.748 | .173 |
| Finger span (cm) | 51.08±2.96 | 52.82±1.92 | 53.47±2.81 | 52.59±3.03 | 1.520 | .224 |

All values are recorded in mean ±standard deviation (Mean ±SD) * The mean difference (MD) is significant at the 0.05 level.

**Table 3.** Bonferroni post hoc

| Characteristics | Institutions | | Mean Diff | P value |
|---|---|---|---|---|
| Thigh girth | Team A | Team B | 7.20909* | .002* |
| Calf Girth | Team A | Team B | 3.80909* | .004* |
| | | Team D | 3.74545* | .005* |
| | Team A | Team B | 3.80909* | .004* |
| | | Team D | 3.74545* | .005* |
| Abdominal Strength | Team A | Team B | 2.81818* | .003* |
| | | Team C | 3.90909* | .000* |
| | | Team D | 2.36364* | .018* |
| Distant Kick | Team A | Team B | 6.46364* | .023* |
| | | Team D | 6.73636* | .016* |

*The mean difference (MD) is significant at the 0.05 level

Table 2 represents the comparison of motor performance and anthropometric characteristics among institutions. There were statistically significant differences in abdominal strength ($F_{(3,40)}$=9.724, p=.000), distant kick ($F_{(3,40)}$=3.211, p=.009), thigh girth ($F_{(3,40)}$=5.353, p=.003) and calf girth ($F_{(3, 40)}$=6.032, p=.002) at .05 level of acceptance.

**Table 4(a).** Distant Kick

| | B | β | T | p-value |
|---|---|---|---|---|
| Summary | | | | .012 |
| (Constant) | 7.212 | | .617 | .540 |
| Weight | .431 | .424 | 2.554 | .015 |
| Thigh Girth | -.014 | -.011 | -.047 | .963 |
| Calf Girth | .263 | .119 | .538 | .594 |

R=.488, $R^2$ =.238, F = 4.16

**Table 4(b).** Dribbling

| | B | β | T | p-value |
|---|---|---|---|---|
| Summary | | | | .056 |
| (Constant) | 24.039 | | 5.167 | .000 |
| Height | -.044 | -.267 | -1.173 | .247 |
| Weight | -.017 | -.114 | -.502 | .619 |
| Summary | | | | .011 |
| (Constant) | 7.306 | | 2.374 | .022 |
| Speed | .663 | .291 | 1.737 | .090 |
| Agility | .274 | .213 | 1.271 | .211 |

R=.362/.444, $R^2$ =.131/.197, F = 3.10/4.04

**Table 5.** Comparison of Anthropometric, Motor Performance and kicking ability of female soccer players and international university female soccer players

| Variable | Mean | SD | t | P value | MD | INV |
|---|---|---|---|---|---|---|
| Height | 160.53 | 5.59 | -6.012 | .000* | -5.07 | 165.60 |
| Weight | 57.66 | 6.12 | -5.576 | .000* | -5.14 | 62.80 |
| Leg length | 79.38 | 5.06 | -3.133 | .003* | -2.39 | 81.77 |
| Thigh Girth | 53.99 | 4.87 | 3.253 | .002* | 2.39 | 51.60 |
| Calf Girth | 37.00 | 2.81 | 4.282 | .000* | 1.81 | 35.19 |
| Upper Arm Length | 33.15 | 1.52 | .548 | .587 | .13 | 33.02 |
| Forearm Length | 28.83 | 1.56 | -.342 | .734 | -.08 | 28.91 |
| Up Arm Girth | 27.67 | 1.59 | 13.55 | .000* | 3.25 | 24.42 |
| Chest Girth | 86.28 | 3.34 | -5.757 | .000* | -2.90 | 89.18 |
| Finger Span | 52.49 | 2.77 | -10.429 | .000* | -4.36 | 56.85 |
| Speed | 6.15 | .40 | 13.137 | .000* | .80 | 5.35 |
| Leg Power | 39.62 | 3.33 | -6.137 | .000* | -3.09 | 42.71 |
| Abd. Strength | 24.18 | 2.22 | -13.480 | .000* | -4.52 | 28.70 |
| Agility | 16.92 | .71 | -.714 | .479 | -.08 | 17.00 |
| Flexibility | 26.14 | 1.86 | 2.276 | .028* | .64 | 25.50 |
| Up Body Strength | 24.73 | 3.11 | -9.126 | .000* | -4.27 | 29.00 |
| Distant Kick | 41.03 | 6.21 | 19.308 | .000* | 18.08 | 22.95 |
| Dribbling | 16.03 | .92 | -14.579 | .000* | -2.01 | 18.04 |
| Accuracy | 4.05 | 1.20 | 3.969 | .000* | .72 | 3.33 |

N=44, df=43. International Normative Values (INV)

Bonferroni post hoc analysis in Table 3 revealed the specific direction of the differences between 'A' and 'B', 'A' and 'C', and 'A' and 'D' in abdominal strength, with 'A' having the least value the kicking ability among university female soccer players. The results also confirmed that the significant differences noticed in Table 2 existed between 'A' and 'B' in thigh girth, 'A' and 'B' in calf girth; and 'D' and 'A' also in calf girth. From the results, 'A' trailed their counterparts in all the descriptive comparisons.

Tables 4(a) and (b) show initial correlation analysis which indicates that, two of the dependent variables of the kicking ability (distant kick and dribbling) correlate low with some of the independent variables (height, weight, thigh girth, calf girth, speed, and agility). Meanwhile, the tolerance and variance inflation factor (VIF) values in the collinearity diagnosis indicate an allowable level of multicollinearity between the independent variables. However, the third dependent variable of the kicking ability (Accuracy) did not correlate with any of the independent characteristics.

The multiple regression analysis ran to predict distant kick from weight, thigh girth and calf girth, dribbling from height and weight and dribbling from speed and agility in Tables 4(a & b) showed that only the weight significantly predicted the distant kick in the model, $R^2 = .238$, $t = 2.554$, $p=.015< 0.05$, the overall model also significantly influenced the distant kick, $R^2 = .238$, $F_{(3,40)}=4.16$, $p=.012 < 0.05$, which accounted for 23.8% of variance. However, the two anthropometric variables (height and weight) in Table 5 together did not statistically significantly predict the dribbling, $R^2 = .131$, $F_{(3,40)}=3.10$, $p=.056 > 0.05$. The two motor performance variables (speed and agility) put together statistically significantly influenced the dribbling $R^2 = .197$, $F_{(3,40)}=4.04$, $p=.011 < 0.05.015< 0.05$ accounting for 19.7% variance of dribbling even though individually, the variables did not.

Table 5 depicts the mean comparison of universities female soccer players' anthropometric, motor performance and kicking ability and that of international university female soccer players using one sample t-test which showed significant differences between all the characteristics of the universities female soccer players measured and their international counterparts ($p<0.05$) except arm length (upper arm and forearm length) and agility.

## 4. Discussion

The study established the analogical and diversification of the anthropometric and motor performance characteristics among the university female soccer athletes. Findings revealed that the mean height of the female soccer players in Ghana universities was relatively the same. Apart from other parameters, this equality in height probably explains why there was only one (1) goal emanating out of an aerial header during the last Ghana university games for female soccer. The finding on the mean height is comparatively lower than their contemporary in the advanced countries as reported in the literature [3,26,27]. The range for body weights perhaps, probably explains why these teams did not have too much advantage over each other in activities such as charging for the ball. Coaches had to resort to tactical discipline to marginally win or draw their matches. Again, the mean weight in this study is less than the value reported [3,20,28].

The value of the mean leg length for the female soccer players may probably be one of the reasons few goals scored in matches between these institutions due to their almost equally stride length and reach for sprint, tackling and blocking with the legs with no undue advantage. The Bonferroni post hoc test also confirmed significant differences between teams. The possible inference from these results could be that team A lost to the other three institutions under this study because the three could probably kick farther and dribble the ball fluently since thigh girth is correlated with dribbling and distant kick [2,3]. The mean scores for calf girth of the female soccer players were significantly different among the players in the teams. It is suggestible that team A lost again to the other three institutions under this study because they were the least in calf girth and as such may not have been able to kick the ball farther. This study revealed a correlation between calf girth and distant kick. Meanwhile, the mean calf girth in this study is less than the value reported [3,29].

The mean mark for the upper arm length of the female soccer players showed greater similarities between all the institutions. These results probably suggest that all the soccer players may have had an equal advantage of throwing-in balls with the same speed and distance. The mean forearm length for the female soccer players implied there was no significant difference in the forearm lengths of the female soccer players. These results probably indicated an equal advantage for all the soccer players throwing-in balls with the same speed and distance. The mean values of the upper arm girth suggested that the female soccer university players may not have had any advantages over each other in any activity related to the upper arm girth. However, it has concluded that the upper arm girth has a significant relationship with throwing in soccer [19,20].

All the female soccer players were having relatively the same chest girth and mean finger span. The probable implication for this equality could be that the players had identical advantages in activities related to chest girth in soccer playing such as trapping the ball with the chest, blocking the opponent, and front charging which agreed with earlier studies [30-32] but less than average individual which is required for female soccer game as stipulated [19,20].

The mean speed for the female soccer players showed indifference among the universities in Ghana. This probably explains why there were not many goals scored between these institutions because the players had equal sprinting advantages and as such could not out-sprint each other to defend or attack. The mean leg power for the female soccer players also reflected equal strength. With this result, the players were expected to kick the ball for equidistantly [33,34] which was not the case probably due to other reasons that can be studied later. Meanwhile, the mean vertical jump in this study is more than average individual which is required for female soccer but less than the baseline result obtained by Maciejczyk et al. [12] in a study that determined the effects of short-term (4 weeks, twice a week:8 sessions) plyometric training on agility, jump, and repeated sprint performance in female soccer players. On the mean of abdominal strength, the female soccer players had different performances. The mean agility for the female soccer players was 16.92±0.71sec which concurred with previous study [3,12]. This result is probably informed by the similarities in the players' heights, weights, leg length and speed. However, this similarity in directional changes suggests the players were equally matched in acting and reacting to swerves in attack and defence and equally good field movement and correct positioning on the pitch to either attack or defend. The mean flexibility for the female soccer players was also indifferent. This possibly explains why there were just minor injuries emanating from over-stretched muscles during play.

The mean score for upper body strength of the female soccer players was also similar suggesting rather greater resemblance between the players' upper body strength. This implied the players may have equal advantages with power to throw-in, run and charge in the games [13,35]. There were variations in the mean score for distant kick for the female soccer players which may be associated with smaller thigh and calf girths which correlate with distant kick as explained earlier on [4,5,22]. There was however no variation in the mean mark for dribbling of the female soccer players which suggests that the players might have relied on dribbling skills equally to outwit their opponents or advance the ball forward and backwards, probably because of the insignificant differences in the speed and agility amongst them which are also correlated with dribbling as seen in previous findings [20,22,36]. The mean score for accuracy of the female soccer players was not different in performance. This implied the players were evenly advantaged with accurate passing of the ball (short and long), shooting on target and goal scoring.

## 5. Conclusions

The influence of anthropometric and motor performance variables on the playing ability of female soccer players revealed that, the thigh and calf girths did not significantly influence the distant kick, but the weight of the players did. However, the whole model significantly influenced the distant kick. The possible attribution from the results could be that university female soccer players could excel at the international level given training intervention on shoot for accuracy. There was significant difference in the thigh girth, calf girth, height, weight, leg length, upper arm length, forearm length, upper arm girth, chest girth, and finger span of the University female soccer players, as far as the institutional anthropometric characteristics model is concerned. Based on motor performance characteristics, there were significant differences in the abdominal strength, speed, leg power, agility, and distant kick of the university female soccer players. Also, there was significant difference between the anthropometric and motor performance characteristics of female soccer players in Ghana and international university soccer players.

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## Conflicts of Interest

Authors had no conflict of interest to declare at the end of this study.

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