PHENOTYPIC CORRELATION OF BODY WEIGHT AND LINEAR BODY MEASUREMENTS IN FOUR BROILER STRAINS REARED IN A SEMI-ARID ZONE OF NIGERIA

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ABSTRACT
This study was conducted at the University of Maiduguri Teaching and research Farm, Maiduguri, Borno State, to evaluate the relationship between body weight and linear body measurements in four strains (*Arbor Acre*, *Cobb500*, *Hubbard*, and *Ross 308*) of popularly reared broiler chickens in Maiduguri. A total of 480 unisex chicks were used for the experiment and data were collected at eight weeks old. Body weight was measured using digital weigh balance, while linear body measurements was obtained using simple tape rule. The correlation between body weight and linear body measurements were determined using Pearson's product moment coefficient of SPSS package. Results revealed significant (P<0.01) phenotypic correlation between body weight and linear body measurements in all strains and sexes. Of all the linear body measurements, chest girth was highly correlated to body weight and had the highest (0.98) correlation value, while shank circumference had the lowest recorded relationship with keel length (0.19). Body weight showed high positive correlation with all body measurements in female broilers across the strains with the exception of Arbor Acre for keel length (0.39). Highly significant (P<0.01) positive correlation was observed in Ross 308 females between body weight and chest girth (0.97). Moderate correlation values between body weight and shank length (0.47), body weight and shank circumference (0.35), chest girth and shank length (0.44), chest girth and shank circumference (0.35) were recorded in male broilers.
Keywords: Broilers, correlation, body weight, morphometric traits, strains.

INTRODUCTION
The poultry industry has emerged as the most commercialized and fastest expanding segment in the animal husbandry subsector (Heise *et al*., 2015). There has been a considerable increase in the poultry industry over time, numerous households now engage in small-scale broiler production in order to support their families, as such; different strains of broilers are marketed under different company labels to meet the demands of producers and consumers alike. Therefore, substantial information on growth is very useful in supporting and maintaining broiler production in the years to come. Non-invasive linear body measurement has been shown to give detailed information on body growth and market value in farm animals and many researchers have been examining the relationship between measurement of size and conformation traits in poultry. These relationships were found to provide useful information on the performance and carcass value of birds. Quantitative traits in broilers are generally the dimension of different body parts and live weight, which is directly related to production parameters. Therefore, the strong correlation with meat yield, body weight is used as proxy indicators of production (FAO, 2012). In poultry, these traits include measurements on chest circumference, wing length, back length, shank length and shank circumference, breast width, keel length, thigh length, pelvis width and body weight, which may vary with genotype, sex and influence of the methods of data analysis (Assan, 2015). This study was designed to investigate the correlation between body weight and linear body measurements in four strains of broilers reared in semi-arid zone of Borno state.

MATERIALS AND METHODS
The study was carried out at the Livestock Teaching and Research farm, University of Maiduguri, Maiduguri, Borno state. Maiduguri, the capital of Borno state is on an altitude of 345 m above sea level and situated between latitude 11.833 N and longitude 13.149 E (Encarta, 2007). The ambient temperature could be as low as 20 ^{0}C during the dry cold season and as high as 44 ^{0}C during the dry hot season. The relative humidity is 45% in August, which usually lowers to about 5% in December and January. Day length also varies from 11 to 12 hours. The experiment was conducted between February and April of 2018. This period of the year is characterized by high ambient temperature and

winds. The temperature ranges from 27 ^{0}C - 40 ^{0}C in February, 29 ^{0}C - 43 ^{0}C in March and 31 ^{0}C - 44 ^{0}C in April, respectively. A total of 480 unisex day-old chicks from four different commercial strains comprising of 120 each of *Abor Acre, Hubbard, Ross 308 and Cobb 500* were used for the experiment. Birds were identified by tagging unique numbers on the shank, were then allocated into four groups with six replications (20 chicks per replicate) in a completely randomized design (CRD), and were kept in a conventional deep litter pen with good ventilation and daylight. Commercially available broiler starter ration (Vital Feeds) which contains 23% CP and 3000 Kcal/Kg ME, and finisher containing 21% CP and 3100 Kcal/Kg ME were provided *ad libitum* between 0-4 and 5-8 weeks, respectively. Individual measurements of body weight and linear body parts were collected at eight weeks. Body weight measurement was carried out using a digital weighing scale calibrated in grams (g), while simple tape rule calibrated in centimetres (cm) was used to record linear body measurements. Chest girth, shank length and circumference, keel length, thigh length, body length, wing length and span were taken as described by (Sola-ojo and Ayorinde, 2011 and Adeleke *et al*., 2011). The coefficient of relationship between body weight and live body measurement traits in each strain were analyzed using Pearson’s Moment Correlation coefficient of SPSS package (2011).

RESULTS AND DISCUSSIONS

The result of the phenotypic correlations between body weight and body measurement of four strains of broilers by sex is presented in Table 1. Body weight shows positive and highly significant ($P<0.01$) correlations with all body measurements across all strains with the exception of keel length in Arbor Acre (0.39). Highly significant ($P<0.01$) positive and strong correlations were recorded between chest girth and shank circumference (0.92), shank length and shank circumference (0.91), shank length and body length (0.87), body length and wing length (0.94) in Arbor Acre strains. Hubbard had a high significant ($P<0.01$) relationship between body weight and thigh length (0.87), chest girth and body length (0.96), shank length and wing length (0.96), wingspan and thigh length (0.96). Similarly, high significant ($P<0.01$) and positive correlations were observed in Ross 308 between body weight and chest girth (0.97), wing length and thigh length (0.96), shank length and keel length (0.81). Egena *et al*. (2014) reported a highly significant and positive correlation coefficient among female indigenous Nigerian chickens. However, Udeh and Ogbu (2011) reported weak values of correlation in Arbor Acre. A positive, moderate and significant correlation was observed between keel length and body weight (0.39), chest girth (0.40), shank length (0.38), body length (0.37), wing length (0.42), wingspan (0.39) as well as thigh length (0.36) in Arbor Acre strain. From the result, keel length in Arbor Acre female is therefore not a perfect indicator for the measurement of growth in the strain. Udeh and Ogbu (2011) also reported moderate correlation values in Arbor Acre. However, the result contradicts the reports of Yahaya *et al*. (2012) who reported a high and significant correlation among linear body measurement in Hubbard and Arbor Acre strains. Strong, positive and significant ($P<0.01$) phenotypic correlation was observed for all body measurements in broiler males of Cobb 500 and Hubbard strains at this age. The result is in accordance with the findings of Ige *et al.* (2016) who observed high phenotypic correlation in male Hubbard strains. The result also implies that linear body measurements were good indicators of body weight in the two strains. Similarly, the relationship between body weight and chest girth in Arbor Acre (0.97) and Ross 308 (0.95) were also strong. The correlation between body weight and shank length (0.73), chest girth and shank length (0.77), were observed to be strong in Ross 308 male strain. Abdel-Lattif (2019), reported a significant correlation between body weight and breast circumference (0.79) only in Ross strain. Moderate correlation values were observed between body weight and shank length (0.47), body weight and shank circumference (0.35), chest girth and shank length (0.44), chest girth and shank circumference (0.35). Shank circumference has a moderate correlation with body weight (0.32), chest girth (0.34), keel length (0.34), body length (0.32), wing length (0.37), wingspan (0.36), and thigh length (0.35). This result contradicts the findings of Ige *et al*., (2016) who observed a strong correlation between body weight and linear body measurements in male Arbor Acre strain. This implies that shank circumference is not a good indicator of body weight in this study for Arbor Acre and the rearing environment might have contributed this. On the contrary, a weak positive but significant ($P<0.01$) correlation values were recorded for shank length and shank circumference in both Arbor Acre (0.16) and Ross 308 (0.27). Ojo *et al*. (2014) also reported a weak correlation between body weight and wing length (0.25), Shank length (0.27), Shank circumference (0.19) and drumstick (0.25) in Japanese quails at 8 weeks of age. Comparably, Udeh and Ogbu (2011) reported a weak correlation between body weight and shank length as well as other linear body measurements in Arbor Acre and Ross strains, respectively. The weak values observed in the current study for Arbor Acre and Ross 308 implies that shank length, shank circumference, keel length, body length, wing length and wing span were weak in explaining the relationship with body weight in the strains.

CONCLUSION AND RECOMMENDATION

The result obtained from this study reveal that highly significant correlation exist between body weight and morphometric traits in all the strains considered. It also shows the degree of relationship among linear body measurements. That Cobb500 and Hubbard strains had the best correlation values for all parameters considered. Chest girth and wingspan had the highest correlation with body weight, therefore, these strains exhibit a peculiar growth pattern as portrayed in this studies.

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Table 1: Pearson correlation between Body Weight and Body Measurements in Females and Males of Arbor Acre, Ross 308, Cobb 500 and Hubbard Strains at 8 Weeks
BW: Bodyweight, CG: Chest Girth, SL: Shank Length, SC: Shank Circumference, KL: Keel Length,

Parameters	Arbor Acre		Cobb 500		Hubbard		Ross 308	
	Female	Male	Female	Male	Female	Male	Female	Male
BW – CG	0.98**	0.97**	0.97**	0.98**	0.90**	0.97**	0.97**	0.95**
BW – SL	0.93**	0.47**	0.94**	0.96**	0.86**	0.94**	0.77**	0.73**
BW – SC	0.90**	0.35**	0.90**	0.94**	0.85**	0.91**	0.87**	0.32**
BW – KL	0.39**	0.95**	0.94**	0.97**	0.89**	0.96**	0.95**	0.92**
BW – BL	0.94**	0.93**	0.94**	0.93**	0.90**	0.94**	0.96**	0.95**
BW – WL	0.93**	0.94**	0.94**	0.95**	0.88**	0.93**	0.94**	0.90**
BW – WS	0.92**	0.90**	0.93**	0.92**	0.85**	0.93**	0.95**	0.91**
BW – TL	0.90**	0.92**	0.92**	0.93**	0.87**	0.94**	0.95**	0.93**
CG – SL	0.95**	0.44**	0.95**	0.96**	0.96**	0.95**	0.78**	0.77**
CG – SC	0.92**	0.33**	0.93**	0.95**	0.92**	0.93**	0.90**	0.34**
CG – KL	0.40**	0.96**	0.95**	0.97**	0.97**	0.97**	0.96**	0.97**
CG – BL	0.95**	0.95**	0.95**	0.94**	0.96**	0.94**	0.96**	0.98**
CG – WL	0.95**	0.96**	0.96**	0.97**	0.95**	0.94**	0.95**	0.96**
CG – WS	0.95**	0.92**	0.95**	0.93**	0.95**	0.94**	0.96**	0.96**
CG – TL	0.92**	0.92**	0.92**	0.93**	0.96**	0.95**	0.96**	0.96**
SL – SC	0.91**	0.16**	0.92**	0.93**	0.94**	0.93**	0.78**	0.27**
SL – KL	0.39**	0.44**	0.94**	0.95**	0.97**	0.96**	0.81**	0.79**
SL – BL	0.94**	0.43**	0.94**	0.92**	0.95**	0.94**	0.78**	0.77**
SL – WL	0.96**	0.46**	0.95**	0.96**	0.96**	0.96**	0.82**	0.79**
SL – WS	0.95**	0.42**	0.95**	0.92**	0.95**	0.95**	0.80**	0.78**
SL – TL	0.91**	0.44**	0.92**	0.93**	0.96**	0.96**	0.79**	0.76**
SC – KL	0.38**	0.33**	0.92**	0.95**	0.94**	0.95**	0.92**	0.34**
SC – BL	0.87**	0.36**	0.89**	0.89**	0.90**	0.91**	0.89**	0.32**
SC – WL	0.91**	0.36**	0.93**	0.93**	0.93**	0.93**	0.93**	0.37**
SC – WS	0.91**	0.35**	0.92**	0.90**	0.93**	0.94**	0.93**	0.36**
SC – TL	0.84**	0.35**	0.87**	0.87**	0.91**	0.91**	0.88**	0.35**
KL – BL	0.37**	0.93**	0.92**	0.92**	0.96**	0.95**	0.95**	0.96**
KL – WL	0.42**	0.96**	0.94**	0.96**	0.97**	0.96**	0.96**	0.96**
KL – WS	0.39**	0.92**	0.93**	0.93**	0.96**	0.96**	0.97**	0.97**
KL – TL	0.36**	0.93**	0.91**	0.93**	0.96**	0.96**	0.96**	0.96**
BL – WL	0.94**	0.95**	0.95**	0.95**	0.95**	0.94**	0.94**	0.95**
BL – WS	0.95**	0.93**	0.97**	0.92**	0.95**	0.94**	0.96**	0.96**
BL – TL	0.93**	0.94**	0.94**	0.93**	0.96**	0.94**	0.95**	0.96**
WL – WS	0.98**	0.95**	0.98**	0.95**	0.97**	0.98**	0.98**	0.98**
WL – TL	0.93**	0.93**	0.93**	0.93**	0.96**	0.96**	0.96**	0.95**
WS – TL	0.93**	0.91**	0.94**	0.91**	0.96**	0.95**	0.96**	0.64**

BL: Body Length, WL: Wing Length, WS: Wing Span, TL: Thigh Length. **Significant at ($P<0.01$).