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Growth Traits and Phenotypic Correlations of Body Weight and Linear Body Traits in F1 Progenies of Local × Exotic Chickens

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Target audience: *Animal breeders, Producers, Farmers, Students*

Abstract

This study examined the body weight, linear body traits and phenotypic correlation among linear body traits of crossbred progenies of indigenous chickens. A total number of 218 F1 progenies were generated from the crosses involving normal feathered local black and brown cocks (3 each from black and brown cocks), and 12 Cobb and Abor acre exotic breeder layers respectively in the mating ratio of 1:4. Data obtained were subjected to an independent t-test using SPSS package. Results revealed significant (P<0.05) genotypic effects on body weight and linear body traits, with Na x COB (normal feathered local cock x Cobb exotic breeder layer) consistently outperforming Na x AA (normal feathered local cock x Abor acre exotic breeder layer) in body weight and linear body traits at each age. In week 8, for instance, Na x COB achieved a mean body weight of 1430.00±20.00g and exhibited superior measurements in body length, wing length, and breast girth, indicating genetic influence on growth traits. Phenotypic correlations between body weight and linear body traits were also strong, particularly in Na x COB, showing that traits like thigh girth and wing length have high predictive potential for body weight. The strong positive correlations suggest pleiotropic effects, making these traits reliable indirect selection criteria for improving body weight. These findings underscore the value of genetic crosses for enhancing growth traits in indigenous chicken lines, presenting potential strategies for targeted breeding programs.

Key words: *body weight, linear body traits, phenotypic correlation, progeny, local, exotic*

Description of Problem

Genetic improvement of chicken is important to increase their contribution to the much-needed animal protein in Nigeria (1). The Nigerian local chickens are known for their small adult size and laying of small-sized eggs when compared to improved commercial broiler or layer birds, respectively (2). They are made of heterogeneous individuals that have variable performance, thus necessitating the need for their genetic diversity to be exploited for genetic improvement and development (3). These genetic blueprints could be exploited by crossing our local hen with selected exotic male breeders in order to develop better strains and improved quality for locally based meat-type or egg-type chickens suitable for use in the tropics. This measure of improvement can be achieved because the Nigerian local hen is composed of many advantageous gene complexes or marker genes that can complement the exotic traits (4). (5) reported increased egg and meat production between a cross of European breeds and native type. (6) reported significant improvement in daily weight gain, a number of eggs and egg weight on cross-breeding of Nigerian indigenous with the Dahlem Red chickens (German breed). This indicates that exotic cock transmits the gene for higher egg production and weight gain. Linear body measurements help in the comparison of growth in different parts of the body. It has been used to characterise strains, evaluate carcass yield, sex effect on performance and predict live weight gain in livestock (7). Linear body measurement and its relationship to size and shape have been extensively studied in both large animals and poultry (8). Linear body measurements have been a recurring interest in livestock production, either to supplement body weight as a measure of productivity or as predictors of some less visible characteristics (9). The live body weight and linear body measurements contribute significantly to the lifetime performance of the animal (10).

The major purpose of assessing the interrelationship between performance parameters and body weight and its associated traits, like body dimensions, is to predict body weight in indigenous chickens where scientific scales are not available. Relationships between body weight and linear body measurements are important for predicting body weight and can also be applied speedily in selection and breeding programmes (11). According to (12), the phenotypic correlation between any two traits is the correlation of their observed values. Previous findings have indicated positive and significant correlations between live weight and body dimensions, that is, body dimensions can be used to predict the body weight of an animal (13). (14) and (15) reported low to high positive phenotypic correlation coefficients between body weight and linear body traits in chickens.

The objective of this study is to evaluate growth traits characteristics of F_1 progenies of local x exotic chicken crosses.

Materials and Methods

Experimental Site

This study was conducted at the Poultry Unit of the Teaching and Research Farm, Michael Okpara University of Agriculture, Umudike, Abia State. The area is located on latitude 05^0 29^1 North and longitude 7^0 32′ East and an altitude of 122 meters above the sea level. It is ecologically situated in the rain forest zone with an annual rainfall of 2177mm, average ambient temperature of 28°C, and relative humidity of 72% as reported by (16).

Breeding Stock and Management

A base population of 30 birds consisting of 3 brown normal feathered and 3 black normal feathered local cocks, female exotic breeder layers (parent stock) consisting of 12 Cobb and 12 Abor Acre at about 20 to 22 weeks of age were selected for the formation of new strains. The female exotic breeder layers were purchased from Zartech and Chimero farms, Ibadan, Oyo State while the local cocks were procured from the local governments in Abia State. The brown normal feathered local cocks were crossed with the Cobb exotic breeder layers, while the black normal feathered local cocks were crossed with the Abor acre exotic breeder layers, which produced the two genotypic progenies. A total number of 218 F_1 progenies were generated from the crosses.

The mating scheme for the generation of F_1 crossbreds is as follows:

BrownNormal feathered local cock x Cobb 500 Exotic breeder layer = (Brown-localCobb) F_1

BlackNormal feathered local cock x Abor acre Exotic breeder layer = (Black-localAbor acre) F_1

Egg setting, incubation and hatching

Eggs from each genetic group were collected daily to prevent the cracking of the eggshell and were not allowed to stay more than 7 days before incubation in order to avoid reduced hatchability due to prolonged storage. Eggs were collected in batches. The eggs to be hatched were covered with polyethene to prevent the drying of the egg content and incubated with an automated cabinet-type incubator at a temperature of 37.7° °C, and 70% humidity. The eggs in the incubator were turned daily to prevent adhesion, and on the 9th day, the eggs were candled to evaluate the percentage fertility index of the eggs. On the 14th day of incubation, the eggs were re-candled to determine the percentage of dead in germ. The incubated eggs hatched between the 20th and 21st day. On arrival at the farm, the chicks were brooded for two (2) weeks according to their genetic groups, and later transferred to the deep litter rearing pens in batches. The chicks were fed a straight diet containing 22.17%CP and 2971.85kcal/kgME. Appropriate vaccinations, medications and water were given as at when due. The experiment lasted for eight (8) weeks.

Data collection

Data was collected from two (2) weeks of age and subsequently at weekly intervals until 8 weeks of age.

Parameters measured include:

Body weight (BWT): was measured weekly using a top-loading 20kg CAMRY scale with a sensitivity of 10g.

Body length (BL): The distance between the base of the neck and pygostyle .

Shank length (SL): Length of the tarso-metatarsus from the hock joint to the metatarsal pad.

Keel length (KL): Length of the keel bone from the v-joint to the end of the sternum.

Wing length (WL): Distance between the tip of the phalanges and the coracoids-humerus joint.

Breast width (BRW): Region of the largest breast expansion when positioned ventrally.

Thigh length (TL): Length of the femur bone.

All linear body parameters were measured weekly using a meter rule and a tailor's tape calibrated in cm.

Phenotypic correlation

The phenotypic correlation between pairs of traits considered was determined using the following expression given by (17).

Phenotypic correlations among body weight and linear body parameters for each of the progenies at the different weeks were associated with Pearson's Product Moment Correlation Coefficients (r) using the same (18) software. The model for the correlation is as shown:

$$r = \frac{\Sigma Xi\, Yi}{\sqrt{\Sigma x^2 i\, \Sigma Y^2 i}}$$

Where;

r = Pearson's correlation

X_i, first random variable of the i^{th} body weight or linear body trait.

Y_i = the second random variable of the i^{th} body weight or linear body trait.

Statistical Analysis

All data obtained were subjected to an independent student T-test to compare means between the two genotypes using (19) version 25. The statistical model is as shown below:

$Y_{ij} = \mu + G_i + e_{ij}$ . . . (1)

Where;

Y_{ij} = Single observation

μ = Overall mean

G_i = Effect of genotype (i = 1-2)

e_{ij} = Random error, assumed to be independently, identically and normal distributed with zero means and constant variance (iind(0,σ^2)).

Results and Discussion

Body weight and linear body traits of the F_1 progenies of local x exotic chicken crosses at weeks 2 to 8

Table 1 shows the body weight and linear body traits of the F_1 progenies of exotic chickens and their Abia ecotype male lines at weeks 2 to 8. The results showed that genotype had significant (P<0.05) influence on body weights and linear body parameters in all the weeks studied, except keel length and thigh length in week 2, body weight, shank length, keel length and thigh girth in week 3, keel length and thigh length in week 4, thigh length and thigh girth in week 6, thigh length in weeks 7 and 8. In week 2, Na x COB had significantly heavier (P<0.05) body weight (188.80g), body length (18.20cm), shank (8.50cm), wings (9.80cm), larger breast (15.60cm) and thigh circumference (6.10cm). In week 3, Na x COB was significantly higher in the mean body length (20.50cm), wing length (11.40cm), breast girth (20.30cm) and thigh length (9.20cm). Na x COB continued to show superiority in body weight (615.00g), body length (24.20cm), shank length (12.20cm), wing length (12.30cm), breast girth (24.00cm) and thigh girth (8.60cm), which were all significantly higher (P<0.05) when compared to Na x AA as seen in week 4. In week 5, Na x COB was significantly higher (P<0.05) in body weight and all linear body parameters, with the mean body weight of 900.00g, body length (27.50cm), shank length (13.30cm), keel length (10.80cm), wing length (13.30cm), breast girth (28.80cm), thigh length (12.30cm) and thigh girth (9.80cm). In weeks 6, 7 and 8, Na x COB progenies had significantly higher (P<0.05) than Na x AA in body weight, body length, shank length, keel length, wing length and breast girth, with the mean values of 1030.00g, 1230.00g, 1430.00g; 28.80cm, 31.40cm, 33.40cm; 13.80cm, 14.20cm, 14.70cm; 11.80cm, 12.20cm, 12.70cm; 13.80cm, 14.20cm, 14.70cm and 30.60cm, 33.40cm, 35.40cm, respectively. Thigh girth was significantly higher (P<0.05) in Na x COB in weeks 7 and 8, with the mean values of 11.40 and 12.40cm, respectively.

The results of the present study revealed a significant genotype effect on body weight and other linear body measurements of birds. This is expected because of variations in the genetic constitutions of the birds, and this is a major determinant of growth and physiological development and which is consistent with the reports of (20). The significant difference in body weight is in line with the reports of (21), (22), (23) and (24). These authors, from their various studies, claimed that growth traits of chickens varied based on the genotype of the chickens. (23) affirmed variations in early growth traits of chicken progenies produced from chicken sires crossed with Fulani ecotype dams, which is in accordance with these current findings.

The significant differences observed in the growth rate of Na x AA and Na x COB in this study implied that the genotypes have different genetic potentials for growth. Body weight ranged from 115.20 – 1190g and 188.80 –1430g for Na x AA and Na x COB, respectively. This affirms the report of (25) that broiler chickens attain market weight of 1300 to 2000g at 8 weeks of age as seen in Na x COB. (26) reported that body weight ranged from 266.67 – 1920 g and 276.33 –1973g for 2-8 weeks Cobb and Arbor Acre, respectively. This range was higher than what was obtained in this study. (27) reported that 12weeks Arbor Acre x Normal feathered crossbred had lowest values for body weight (1005.05g), body length (12.64 cm), keel length (4.68 cm), shank length (2.35 cm), breast girth (9.17 cm), thigh length (6.10 cm) and wing length (5.80 cm) in their study on growth performance traits of crossbred chickens. These values were lower than the values obtained in this study. (28) in their study observed that F_1 progeny of local x exotic chicken crosses at week 2, 4 and 6 were significantly different ($P<0.05$) among body weight and linear body parameters of the various genetic groups at the different weeks, which is in agreement with the findings of this present study. (28) reported that Ross 308 sire x Brown dam and Ross 308 sire x Black dam genotypes had higher body weights (198.53g and 171.00 g at week 4 and Ross 308 sire x Brown dam genotype (245.58g) which was not significantly ($P>0.05$) different from Ross 308 sire x Black dam genotype (223.14g) at week 6, Ross 308 sire x Brown dam had higher body weight of 541.65g in week 8, which was not significantly different ($P>0.05$) from Ross 308 sire x Black dam (461.14g) and Arbor Acre sire x Brown dam (461.83g). Arbor Acre sire x Brown dam and Arbor Acre sire x Black dam had the lowest values of 141.17 and 106.28g in week 4, 189.59 and 189.06g in week 6 and 421.17g in week 8 for Arbor Acre sire x Black dam. These values were lower than the values obtained in this present study. (29) reported the body weight of Arbor Acre x local normal feathered hen at 6 weeks to be 208 ± 23.4 g, which was lower than the value obtained for Na x AA in same week.

(30) reported the body weight, body length and shank length of indigenous normal feathered hen crossed with exotic to be 353.00g (higher than the 253.60g obtained in Na x AA), 33.43 cm and 4.03 cm at week 4, respectively, except for BL which was higher than the values obtained in this study, the shank length were lower than what was obtained in this study. (30) also reported the body weight, body length, and shank length of indigenous normal feathered hen crossed with exotic to be 846.65 g, 53.37 cm and 6.56 cm at week 8, respectively, which were lower than the values reported in this present study. The body weights and shank length obtained in this present study were higher than those reported by (31) at the same week. The significant variation in BW and linear body measurements of the resulting

Table 1: Means±SEM of Body Weight and Linear Body Traits of the progenies of ExoticChickens and their Abia Ecotype Male Line Crosses

Age (weeks)	Genotype	BWT (g)	BL (cm)	SL (cm)	KL (cm)	WL (cm)	BRGT (cm)	TL (cm)	TG (cm)
2	Na x AA	---	16.60±0.24	6.80±0.20	5.80±0.20	8.80±0.20	13.60±0.40	6.80±0.20	5.40±0.19
	Na x COB	188.80±5.91	18.20±0.12	8.50±0.00	6.40±0.24	9.80±0.20	15.60±0.24	7.40±0.24	6.10±0.19
Sig (2-tail)		**0.04**	**0.00**	**0.00**	**0.09**	**0.01**	**0.00**	**0.09**	**0.03**
3	Na x AA	196.60±6.12	18.70±0.25	9.40±0.24	7.80±0.25	9.00±0.00	16.40±0.24	8.40±0.24	6.40±0.24
	Na x COB	389.20±3.18	20.50±0.16	9.40±0.19	7.70±0.12	11.40±0.19	20.30±0.20	9.20±0.12	6.40±0.19
Sig (2-tail)		**0.15**	**0.00**	**1.00**	**0.73**	**0.00**	**0.00**	**0.02**	**1.00**
4	Na x AA	253.60±3.56	20.20±0.12	9.70±0.202	8.70±0.25	10.40±0.24	20.00±0.00	10.40±0.24	7.20±0.12
	Na x COB	615.00±23.56	24.20±0.12	12.20±0.12	9.40±0.24	12.30±0.20	24.00±0.40	10.40±0.24	8.60±0.29
Sig (2-tail)		**0.00**	**0.00**	**0.00**	**0.08**	**0.00**	**0.00**	**1.00**	**0.00**
5	Na x AA	430.00±5.58	21.90±0.37	10.80±0.12	9.30±0.12	11.90±0.19	22.90±0.29	10.90±0.19	8.80±0.25
	Na x COB	900.00±22.36	27.50±0.22	13.30±0.12	10.80±0.12	13.30±0.12	28.80±0.34	12.30±0.12	9.80±0.12
Sig (2-tail)		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**
6	Na x AA	557.40±19.18	24.30±0.12	11.70±0.34	10.40±0.19	12.20±0.12	26.90±0.19	12.60±0.29	10.40±0.24
	Na x COB	1030.00±30.00	28.80±0.20	13.80±0.12	11.80±0.20	13.80±0.12	30.60±0.24	12.60±0.19	10.40±0.24
Sig (2-tail)		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.00**
7	Na x AA	910.00±29.15	27.30±0.20	12.40±0.19	10.40±0.19	12.80±0.12	28.30±0.20	12.70±0.25	10.60±0.24
	Na x COB	1230.00±20.00	31.40±0.24	14.20±0.12	12.20±0.12	14.20±0.12	33.40±0.24	13.20±0.12	11.40±0.24
Sig (2-tail)		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.12**	**0.05**
8	Na x AA	1190.00±24.49	29.60±0.19	13.90±0.29	11.70±0.20	15.30±0.20	30.80±0.49	13.40±0.24	11.60±0.24
	Na x COB	1430.00±20.00	33.40±0.24	14.70±0.12	12.70±0.12	14.70±0.12	35.40±0.24	13.70±0.12	12.40±0.24
Sig (2-tail)		**0.00**	**0.00**	**0.04**	**0.00**	**0.03**	**0.00**	**0.31**	**0.05**

Sig (2-tail) = Significance ($P<0.05$), Na = Normal feathered local cock, AA= Abor acre, COB= Cobb, BWT= Body weight, BL= Body length, SL= Shank length, KL= Keel length, WL= Wing length, BRGT= Breast girth, TL= Thigh length, TG= Thigh girth progenies arising from the effect of genotypes is consistent with the reports of (32) and (31) in which breed differences had a significant effect on the growth performance of different strains of birds. These inconsistencies between results obtained and earlier findings could be due to strain differences as well as environmental and managerial deviations, as stated by (28).

Phenotypic Correlation between Body Weight and Linear Body Traits of F_1 Progenies of Local x Exotic chicken crosses

Table 2 shows the phenotypic correlation coefficients between the body weight and linear body traits in Na x AA in weeks 2 and 4. The correlation coefficients between BWT and linear body traits of Na x AA indicated that the linear body traits evaluated had linear values from weak to strong positive correlation coefficients. In week 2 (lower diagonal), the relationship between BWT and BL had a significant (P<0.05) positive and strong correlation coefficient of 0.90, while the relationship between SL and KL, WL, BRG and TL had significantly (P<0.01) strong correlation coefficients of 1.00 each. The relationship between KL and WL; KL and BRG and between KL and TL also had significantly (P<0.01) strong correlation of 1.00 each. No significant correlation (P>0.05, 0.01) was found between TG and all the linear body traits and between BWT and SL, KL, WL, BRG, TL and TG. The weakest correlation found in week 2 was the relationship between TG and BL (0.327). (33) reported the relationship between body weight and linear body traits to range from 0.39 to 0.40 for Normal feathered x Isa Brown, these values were lower than the values obtained in this work. In week 4 (upper diagonal), the correlation coefficients between BWT and morphometric traits indicated that the morphometric traits assessed had linear values from weak to strong positive correlation coefficients except for BWT and KL, KL and BL, WL and KL, BRG and KL, TL and KL, TG and KL, which had non-significant (P>0.05, weak negative correlation values of -0.281, -0.320, -0.320, -0.166, -0.320 and -0.320, respectively. However, a positive correlation (P<0.05) was observed between BWT and BL, WL, TL, TG while the relationship between WL and BL, TL and BL, TG and BL, TL and WL, TG and WL, TG and TL had high significant (P<0.05) positive correlation coefficient of 1.00. In week 4, the strongest phenotypic correlation existed between WL and BL (1.00), TL and BL (1.00), TG and BL (1.00), TL and WL (1.00), TG and WL (1.00), TG and TL (1.00), while the weakest phenotypic correlation existed between BRG and KL®= -0.166).

The phenotypic correlation between the linear body traits for Na x AA at weeks 6 and 8 is presented in Table 3. The phenotypic correlation between body weight and linear body measurements at week 6 (lower diagonal) showed that WL and TG (1.00) and BRG and TL (0.963) were strong and highly significant (P<0.05) and positively correlated. Body weight and all the linear body traits were non-significant but positively correlated except SL, which negatively correlated with body weight (-0.291). The relationship between BL and SL, KL were weak, negatively correlated (-0.361 and -0.218) and non-significant. Similarly, the relationship between SL, KL, SL and BRG, SL and TL and between KL and WL, KL and TG, were negative and non-significantly correlated. In week 8 (upper

Table 2: Phenotypic Correlation Coefficients among Linear Body Parameters for Na x AA Progenies at 2 weeks of age (lower diagonal) and 4 weeks of age (upper diagonal)

	BWT	BL	SL	KL	WL	BRG	TL	TG
BWT	1	.906*	.309	-.281	.906*	.518	.906*	.906*
BL	.901*	1	.612	-.320	1.000**	.591	1.000**	1.000**
SL	.727	.612	1	.294	.612	.349	.612	.612
KL	.727	.612	1.000**	1	-.320	-.166	-.320	-.320
WL	.727	.612	1.000**	1.000**	1	.591	1.000**	1.000**
BRG	.730	.614	1.000**	1.000**	1.000**	1	.591	.591
TL	.727	.612	1.000**	1.000**	1.000**	1.000**	1	1.000**
TG	.702	.327	.535	.535	.535	.538	.535	1

*. Correlation is significant at the 0.05 level, **. Correlation is significant at the 0.01 level, Na=Normal feathered local cock, AA=Abor acre, BWT= Body weight, BL= Body length, SL= Shank length, KL= Keel length, WL= Wing length, BRGT=Breast girth, TL=Thigh length, TG=Thigh girth

diagonal), no significant correlations were observed between BWT and all the linear body traits and among the linear body traits except, the relationship between TL and BRG, which was strong, positive and significantly correlated (1.00) and TG was significantly correlated with SL (0.910). The strongest phenotypic correlation in week 6 existed between TG and WL (1.00), TL and BRG (0.963), while the weakest phenotypic correlation existed between KL and BL (r= -0.218), SL and BWT (r=-0.291), similarly, in week 8, the strongest correlation was seen between TL and BRG (1.00), followed by SL and TG (0.910) while the weakest correlation was the relationship between KL and WL (0.250).

The phenotypic correlations observed in Na x AA in weeks 6 and 8 were mostly weak and non-significant except for the relationship between TG and WL, TL and BRG in week 6 and TL and BRG, TG and SL in week 8 which had positive and strong significant values, which implies a very strong association between the linear body parameters. The present results contradicts the findings of (34) who reported positive and very highly significant correlations for three genetic groups of native chickens in Nigeria. (35) found positive and very highly significant relationship for body weight and body measurements in crossbred progenies of Nigerian chickens.

(36) observed that the phenotypic correlation coefficient of growth performance traits of Arbor acre x normal feather crossbred chicken were positive and very strongly significant (P<0.001) correlations, they reported the relationship between BW and BL (0.91), BRG (0.95), KL (0.82), SL (0.60), TL (0.78) and WL (0.87). He reported the relationship between BL against BRG (0.92),

KL (0.89), SL (0.43), TL (0.90), WL (0.83) were found to be positive and very highly significant correlated (P<0.001). Positive and very strong significant (P<0.001) correlations were observed between BRG and KL (0.89), SL (0.64), TL (0.85), and WL (0.92). The relationship between KL and SL (0.57), TL (0.91), and WL (0.89) were found to be positive and very strong and significantly correlated (P<0.001). The positive and very strong significant (P<0.001) correlations were recorded between SL and TL (0.33), WL (0.80). The relationship between TL and WL (0.76) was positive and very significantly correlated (P<0.001). The positive and strong significant results obtained by the above author may be due to the age of the birds, as 12-24 weeks old birds were used against the 8-week-old birds in the present work. (33) had observed in his work that RP generally increased with age between body weight and linear body traits. Similar observations were also made by (35) between body weight and shank length, thigh length, breast girth and keel length at 4 and 20 weeks of age in pure and crossbred progeny of Nigerian indigenous chickens.

Table 3: Phenotypic Correlation Coefficients among Linear Body Parameters for Na x AA Progenies at 6 weeks of age (lower diagonal) and 8 weeks of age (upper diagonal)

	BWT	BL	SL	KL	WL	BRG	TL	TG
BWT	1	.873	.840	.868	.663	.583	.583	.667
BL	.849	1	.733	.869	.468	.873	.873	.764
SL	-.291	-.361	1	.514	.772	.490	.490	.910*
KL	.038	-.218	-.709	1	.250	.612	.612	.408
WL	.396	.667	.361	-.873	1	.408	.408	.612
BRG	.853	.873	-.709	.286	.218	1	1.000**	.667
TL	.705	.840	-.809	.275	.210	.963**	1	.667
TG	.396	.667	.361	-.873	1.000**	.218	.210	1

*. Correlation is significant at the 0.05 level, **. Correlation is significant at the 0.01 level, Na=Normal feathered local cock, AA=Aboracre, BWT=Body weight, BL= Body length, SL= Shank length, KL= Keel length, WL= Wing length, BRGT= Breast girth, TL=Thigh length, TG= Thigh girth

Table 4 shows the phenotypic correlations amongst the linear body traits for Na x COB at weeks 2 and 4. In week 2 (lower diagonal), there were strong, positive and significant (P< 0.01) correlations between BWT and BL (0.981), KL (0.981), TL (0.981); BL and KL (1.00), TL (1.00); KL and TL (1.00), while BWT was positive and significantly (P<0.05) correlated with TG (0.909). The relationship between SL and BRG (-0.881) was negative and significantly (P<0.05) correlated. The correlation coefficients ranged from weak (-0.294) to high (1.00), with the strongest correlations found between BL and KL (1.00), BL and TL (1.00), KL and TL (1.00), followed by BWT and BL (0.981), BWT and TL (0.981) and the weakest correlation were found between SL and BRG (-0.294). The negative and significant relationship observed between SL and BRG is an indication that an improvement in one trait can result in improvement in another if a reduction of the second trait is desired (37). The negative estimates of phenotypic correlation between the linear body traits obtained in this study were similar to those reported by (38) in Isa Brown and Ilorin ecotype chickens. (39) explained that environmental factors, including disease, could cause such a negative correlation between traits. Indirect selection of body weight based on a negative correlation response from the linear traits will adversely affect body weight. Hence, (40) suggested that traits exerting such negative correlated responses should be considered separately for the selection program as a way of circumventing their adverse effect on body weight.

In week 4 (upper diagonal), BWT correlated positively and significantly (P<0.05) with BL (0.953), SL (0.953), KL (0.922), TL (0.943), while BWT was strong, positive and significant (P<0.01) with WL (0.982) and TG (0.983). The relationship between SL and BL; KL and BL, SL, TL and BL; TL and SL; TL and KL were strong, positive and significant (P<0.01) with a coefficient of 1.00, respectively. WL and BL, SL, KL were significant and positively (P<0.05) correlated with coefficients of 0.919, 0.912 and 0.910, respectively. The relationship between TG and all other linear body traits were positive and significantly (P<0.05) correlated. All the correlation coefficients in week 4 are moderate to high (0.612-1.00) and significant, except BRG, which shows positive and non-significant (P>0.05) correlation with all linear body traits (except TG). The positive correlation coefficient values are an indication that as one linear body parameter increases, a corresponding increase is expressed in the body weight, and as one linear body parameter increases, a corresponding increase is expressed in the

Table 4: Phenotypic Correlation Coefficients among Linear Body Parameters for Na x COB Progenies at 2 weeks of age (lower diagonal) and 4 weeks of age (upper diagonal)

	BWT	BL	SL	KL	WL	BRG	TL	TG
BWT	1	.953*	.953*	.922*	.982**	.783	.953*	.983**
BL	.981**	1	1.000**	1.000**	.919*	.612	1.000**	.910*
SL	-.358	-.320	1	1.000**	.912*	.622	1.000**	.910*
KL	.981**	1.000**	-.320	1	.910*	.612	1.000**	.910*
WL	.499	.408	-.294	.408	1	.719	.919*	.943*
BRG	.711	.667	-.881*	.667	.612	1	.612	.879*
TL	.981**	1.000**	-.320	1.000**	.408	.667	1	.910*
TG	.909*	.873	-.367	.873	.802	.764	.873	1

*. Correlation is significant at the 0.05 level, **. Correlation is significant at the 0.01 level, Na=Normal feathered local cock, COB=Cobb, BWT= Body weight, BL= Body length, SL= Shank length, KL= Keel length, WL= Wing length, BRGT= Breast girth, TL= Thigh length, TG= Thigh girth

other linear parameter correlated with it.

The phenotypic correlations amongst the linear body traits for Na x COB at weeks 6 and 8 is presented in Table 5. For week 6 (lower diagonal), strong and positive but non-significant correlation (P>0.05) was observed in the relationship between BWT and linear body traits except with TL (0.980), which was strong, positive and significant (P<0.01) and TG (0.953) which was positive and significant (P<0.05). Strong and positive correlation was observed between BL and KL (1.00), SL and WL (1.00), SL and BRG (1.00), WL and BRG (1.00). In week 8 (upper diagonal), BWT was positively correlated (P<0.05) with all the linear body traits with the correlated coefficients of 0.912, 0.910, 0.969, 0.919, 0.944, 0.963 and 0.919 for the relations between BWT and BL, SL, KL, WL, BRG, TL and TG, respectively. The relationship among the linear body traits were strongly and positively correlated (P<0.01) with coefficients of 1.00.

All the morphometric traits in Na x COB in week 8 showed strong and significant (P<0.01) correlations. This implies that increase in any of these traits will lead to increase in BWT and vice versa. This result agreed with the report by (41) that high and positive phenotypic correlations exist between body weight and other body parameters. The positive and significant correlation among the body measurement observed in Na x COB in week 8 indicated high predictability among the variables as reported by (42). The positive correlation between body weight and all of the linear body measurements showed that body weight can be predicted from the linear body measurement. (43) observed that phenotypic correlations between body weight and linear body measurements (morphometric) of the four Strains (Frizzle feathered, Naked neck, Noiler and Normal feathered) of Nigerian local chickens were positive and highly significant for all parameters. They reported low to very high phenotypic correlations coefficients between body weight and linear body measurements (r= 0.18 - 0.96). The strongest phenotypic correlation existed between WL and BL (r=0.96) respectively followed by DSL and BW, BRG and BL, SL and BL(r=0.94) respectively, which was similar to the findings of this study. The strong and significant (P<0.01) correlation obtained by the genotypes was in line with the report of (44), who reported a strong and positive phenotypic correlation between body weight and morphometric traits of seven chicken strains. (45) also reported a very strong and highly significant (P<0.01) correlation between body weight and morphometric traits of Fulani ecotype chickens. Similarly, (11) and (46) had reported shank length and thigh length in chicken and quail, respectively as the best predictors of body weight based on their positive relationship. (47) also obtained high and positive phenotypic correlation between shank length and body weight and opined that it was possible to predict body weight of live Rhode Island chickens on the basis of their shank length measurement. The higher phenotypic correlation estimates of Na x COB than Na x AA proves that the former have faster growth rate than the later. This result agrees with the findings of (29). The positive correlation between the body weight and other variables indicate pleiotropy which means that body weight can be predicted by any of the variables.

Conclusions and Applications

1. It was revealed in this study that

Table 5: Phenotypic Correlation Coefficients among Linear Body Parameters for Na x COB Progenies at 6 weeks of age (lower diagonal) and 8 weeks of age (upper diagonal)

	BWT	BL	SL	KL	WL	BRG	TL	TG
BWT	1	.912*	.910*	.969*	.919*	.944*	.963*	.919*
BL	.667	1	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**
SL	.748	.612	1	1.000**	1.000**	1.000**	1.000**	1.000**
KL	.667	1.000**	.612	1	1.000**	1.000**	1.000**	1.000**
WL	.748	.612	1.000**	.612	1	1.000**	1.000**	1.000**
BRG	.748	.612	1.000**	.612	1.000**	1	1.000**	1.000**
TL	.980**	.802	.764	.802	.764	.764	1	1.000**
TG	.953*	.408	.667	.408	.667	.667	.873	1

*. Correlation is significant at the 0.05 level, **. Correlation is significant at the 0.01 level, Na=Normal feathered local cock, COB=Cobb, BWT= Body weight, BL= Body length, SL= Shank length, KL= Keel length, WL= Wing length, BRGT= Breast girth, TL= Thigh length, TG= Thigh girth

growth trait characteristics were affected by genetic group, indicating that genotype had a significant impact on the performance of the birds.

2. The study also revealed that body weights and linear body measurements increased as age increased in the two genotypes, which shows that these body measurements were directly proportional to age.
3. This study observed that the relationship between the body weight and other linear body traits of these crossbred chickens also revealed a pleiotropic action and this is a good indicator for selection for improvement in one trait. The positive correlations is an indication that increase in one body trait will lead to an increase in the other.
4. The study also revealed that body weight and linear body traits of Nigerian chickens can be improved through crossbreeding.
5. The study also revealed that Normal feathered local cock and Cobb (Na x COB) is best suited for improving the indigenous/local strain in the study area.

References

1. Ganiyu, S.O., Olowofeso, O., Adeyemi, Y.V. and Sanda, A.J. (2016). Strength and nature of relationship between body weight and linear body measurements in Anak white broiler chicken in Abeokuta, Nigeria. In Proc. 41st Conf. Nig. Soc. for Ani. Prod. 20-24 March, 2016. Federal University of Agriculture, Abeokuta, Ogun State, Nigeria.
2. Gondwe, T.N.P. (2004). Characteristics of local chicken in low input-output production system: is there scope for appropriate production and breeding strategies in Malawi? PhD thesis. Georg-August-

University at Gottingen, Germany, 18pp.

3. Fayeye, T.R., Adeshiyan, A.B. and Olugbami, A.A. (2005). Egg traits, hatchability and early growth performance of the Fulani-ecotype chicken. *Livestock Research for Rural Development*, 17 (8): 1-7.

4. Sonaiya, E.B., Branckaert, R.D.S. and Guèye, E.F. (1999). Research and development options for family poultry. Introductory paper to the First INFPD/FAO electronic conference on family poultry, December, 1998 to July, 1999.

5. Magothe, T.M., Okeno, T.O., Muhuyi, W.B. and Kahi, A.K. (2012). Indigenous chicken production in Kenya: I. Current status. *World's Poultry Science Journal*, 68 (1): 119–132.

6. Adedokun, S. A and Sonaiya, E. B. (2002). Crossbreeding Nigeria indigenous with the Dahlem Red chickens for improved productivity and adaptability, *Archiv Tierzucht Dummerstorf*, 45 (3):297–305.

7. Oke, U.K., Okoro, I.C. and Obi, O.C. (2014).Characterization of physical body traits and carcass evaluation of guinea fowl in a humid tropical environment. *International Journal of Agriculture Innovations and Research*, 2(6): 2319-1473.

8. Ogah, D. M. (2011). *In vivo* prediction of live weight and carcass traits using body measurements in indigenous guinea fowl. *Journal of Biotechnology in Animal Husbandry*, 27(4): 1827-1836.

9. Sapriyantono, A., Tomiyama, M. and Suzuki, K. (2012).Estimation of covariance components and genetic parameters of withers height, chest girth and body length of Bali cattle using animal model. *International Journal of Molecular Zoology*, 2(5): 45-50.

10. Chineke, C.A. (2005). The relationship among body weights and linear dimensions in rabbit breed and crosses. *Journal of Animal and Veterinary Advances*, 4(9): 775-784.

11. Ukwu, H. O., V. M. O. Okoro and R. J. Nosike (2014). Statistical modeling of body weight and linear body measurements in Nigerian indigenous chicken. *IOSR Journal of Agriculture and Veterinary Science*, 7 : 27-30.

12. Ibe, S.N. (1998). An Introduction to Genetics and Animal Breeding, Longman Nigeria Plc, Ikeja, Nigeria.

13. Olawumi, S.O. (2013). Phenotypic correlations between live body weight and carcass traits in Arbor acre breed of broiler chicken. *International Journal of Science and Nature*, 4: 145-149.

14. Adebambo, O.A., Ozoje, M.O., Adebambo, F. and Abiola, S.S. (2006). Genetic variations in growth performance Giriraja, Indian White Leghorn and Improved Indigenous chicken breeds in South West Nigeria. *Nigerian Journal of Genetics*, 20:7-16.

15. Adedeji, T.A., Ojedapo, A.O., Ige, S.A., Akinwunmi, A.O. and Amao, S.R. (2008). Genetic evaluation of growth performance of pure and crossbred chicken progenies in a derived savannah environment. Proceedings of 13th annual

conference of Animal Science Association of Nigeria, ABU, Zaria, Nigeria: 15-19 Sept 2008, pp. 8-12.

16. NRCRI. (2017). Agro-Meteorologic unit, National Root Crop Research Institute, Umudike, Abia State, Nigeria.

17. Becker, W.A. (1984). Manual of Quantitative Genetics. 4th Ed. Academic Enterprises, Pullman, Washington, USA.

18. SAS. (2004). User's Guide: Statistics, Version 9.1. SAS institute Inc. Cary, NC, USA.

19. SPSS (2017). Statistical Package for Social Sciences. SPSS Version 25 IBM Inc. 444 Michigan Avenue, Chicago, IL60611, USA.

20. Adedeji, T.A., S.A., Amusan, and O.A. Adebambo (2015a). Effect of chicken genotype on growth performance of pure and crossbred progenies in the development of a broiler line. *International Journal of Agriculture Innovations and Research*, 4(1): 134 – 138.

21. Assefa, H. and Melesse, A (2018) Morphological and morphometric characterization of indigenous chicken populations in Sheka Zone, South Western Ethiopia. *Poultry Fish and Wildlife Science*, 6 (2): 1-9.

22. Amao, S.R. (2018a). Early growth characteristics of chicken progenies derived from different chickens sires on fulani ecotype dams in southern guinea savanna environment of Nigeria. 7th ASAN-NIAS Joint Annual Meeting, Ilorin, 9th -13 Sept, 2018. Pp 174-178.

23. Amao, S.R. (2018b). Application of principal component analysis on the body morphometric of Nigerian indigenous chickens reared intensively under southern guinea savanna condition of Nigeria. *Journal of Environmental Issues and Agriculture in Developing Countries*, 10 (1): 1-12

24. Ojedapo, L.O., Amao, S.R. and Akinwale, D.V. (2018). Effect of genotype on early growth traits of pure and crossbred chicken progenies under derived Savanna zone of Nigeria. 7th ASAN-NIAS Joint Annual Meeting, Ilorin, 9th -13 Sept, 2018. Pp 79-83.

25. Turner, J., Garces, L. and Smith, W. (2005). The welfare of broiler chickens in the European Union. Compassion in the world farming trust.

26. Obike, O. M., Nosike, R. J., Onunkwo, D. N.,Obi, O. C., Obasi, E. N. and Ofo, M. (2017). Growth rate, phenotypic correlation and repeatability estimates of body weight and linear body traits of Cobb and Arbor Acre broiler strains. *Nigerian Journal of Animal Production*, 44(1):39 – 47.

27. Amao, S.R. (2019). Growth performance traits of meat-type chicken progenies from a broiler line sire and Nigerian indigenous chickens' dams reared in southern guinea savanna condition of Nigeria.

28. Obike, O. M., Chijioke, E. I., Akinsola, K. L., Ezimoha, O. C., Isaac, U. C. and Oke, U. K. (2022). Growth performance and carcass characteristics of F1 progenies of local x exotic chicken crosses. *Nigerian Journal of Animal Science*,

24 (2): 18-29.

29. Nwachukwu, E. N., Ibe, S. N., Ejekwu, K. and Oke, U. K. (2006). Evaluation of growth parameters of main and reciprocal crossbred normal, naked neck and frizzle chickens in a humid tropical environment. *Journal of Animal and Veterinary Advances*, 5: 542- 546.

30. Abbaya, H. Y., Akpa, G. N., Alabi, I. I. and Orunmuyi, M. (2017). Comparative study of body weight and some biometric parameters of progenies of indigenous chickens and their Napri crosses. Proceedings of the 42nd Nigerian Society for Animal Production (NSAP) Annual Conference, Omu-Aran, Kwara State. Pp. 85 –88.

31. Hossain, M.J and Ahmed, S. (1993). Body weight of indigenous Rhode Island Red and Barred Plymouth rock chicken. *Animal Breeding Abstract*, 9361:8:528.

32. Nallaba, P., Lokanath, G.R and Ramappa, B.S. (1992). Relative performance of broiler strains. *Animal Breeding Abstract*, 60:514.

33. Isaac UC, (2021). Phenotypic, genetic and environmental correlations between body weight and linear body traits of chicken genotypes. *Agrobiological Records* 4: 32-43.

34. Egahi, J.O., Dim, N.I. and Momoh, O.M. (2013).Crossbreeding and reciprocal effect on egg weight, hatch weight and growth pattern and the interrelationships between these traits in three genetic groups of native chickens of Nigeria. *Asian Journal of Biological Sciences*, 6: 187-191.

35. Adeleke MA, Peters SO, Ozoje MO, Ikeobi CON, Bamgbose MA and Adebambo OA, (2011). Genetic parameter estimates for body weight and linear body measurements in pure and crossbred progenies of Nigerian indigenous chickens. *Livestock Research and Rural Development* 23.

36. Amao, S. R. (2020). Growth performance traits of meat-type chicken progenies from a broiler line sire and Nigerian indigenous chickens' dams reared in southern guinea savanna condition of Nigeria. *Discovery* 56(289), 66-73.

37. Akanno, E.C. and Ibe, S.N. (2005). Estimates of genetic parameters for growth traits of domestic rabbits in the humid tropics. *Livestock Research for Rural Development*, 17 (7).

38. Fayeye TR, Hagan JK and Obadare AR, (2014). Morphometric traits and correlation between body weight and body size traits in Isa brown and Ilorin ecotype chickens. *Iranian Journal of Applied Animal Science*, 4: 609-614.

39. Assan N, (2015). Methodology and factors influencing the association of body weight, performance parameters with linear body measurements assessment in poultry. *Scientific Journal of Pure and Applied Sciences*, 4: 200-210.

40. Tongsiri S, Jeyaruban MG, Van Der Werf JH and Thummabood S, (2014). Genetic parameters for production traits of Rhode Island Red and White Plymouth Rock breeds selected under tropical condition in Thailand.

Proceedings of 10thWorld Congress of Genetics Applied To Livestock Production, pp: 854-856.

41. Okoro,V.M. O. and Ogundu, U. E. (2006). Genetic variabilities of growth traits in twoTurkey breeds in South Eastern Nigeria. In: Proceedings of the 13th Annual Conference of the Nigerian Society ofAnimal Production, (13): 5-8.

42. Pundir, R. K., Singh, P. K. and Dangi, P. S. (2011). Factor analysis of biometric traits of Kankrej cows to explain body conformation. *Asian-Australian Journal of Animal Science,* 24 (4): 449-456.

43. Nweke-Okorocha, O.G., Agaviezor, B.O., Gunn, H.H. and Chineke, C.A. (2022). Polymorphism in Pou Class 1 Homeobox 1 (Poulf1) Gene in Nigerian Indigenous and Improved Chickens Raised in South-South Nigeria. *Journal of Research in Agriculture and Animal Science*, Volume 9, Issue 3: pp. 5-11.

44. Atansuyi, A. J., Ihendu, U. C. and Chineke, C. A. (2018). Growth performance, correlation and regression estimates of seven-chicken strains in South-Western Nigeria. *Nigerian Journal of Animal Production. 45(2): 40 – 48.*

45. Ogunshola, O.J., Daramola, S.A., Omotoso, O.B., Baki, O.I. and Chineke, C.A. (2017). Body weight and and morphometric triats of Fulani ecotype chickens in south western Nigeria are closely related. *Nigerian Journal of Animal Production*. 44(5): 19-23

46. Nwogwugwu, C.P., Lee, J.H., Egbu C, F., Lee, S. (2018). Review on the genetic potential of Nigerian local chickens. *Journal of Animal Breeding and Genomic,* 2(4): 199-211.

47. Kabir, M., Oni, O.O., Akpan, G.N. and Adeyinka, I.A. (2006). Heritability estimates and the interrelationships of body weight and shank length in Rhode Island Red and White chickens. *Pakistan Journal of Biological Sciences*, 9 (15): 2892-2896.