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Correlation between Body Weight and Morphometric Traits in Nigerian Mixed-Breed Rabbits

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ABSTRACT: Estimates of phenotypic, genetic, and environmental correlations between body weight (BW) and morphometric traits (i.e. Body Length - BL, Length of Leg - LL, Head to Shoulder - HS, Shoulder to Tail - ST, Body Girth - BG and Ear Length - EL) were determined at 1, 2, 7 and 8 weeks of age in forty (40) non-descript Nigerian local rabbit kits. The phenotypic correlations between body weight and all morphometric parameters were positive (0.26-0.90) except for BL (-0.11) in week 1. Genetic correlations between body weight and morphometric parameters were highly positive in weeks 1 and 2 (0.35-0.98) except for BG (0.21). Lower estimates of genetic correlations were obtained in weeks 7 and 8. Environmental correlations (r_E) between body weight and morphometric parameters were mostly negative. r_E values were generally lower (compared with r_P and r_G) for the same set of traits. ST, HS and LL were more consistently phenotypically and genetically correlated with body weight and can therefore be used to achieve early selection for body weight among local rabbits in Nigeria.

Key words: Body weight, Morphometric traits, Correlations, Rabbits.

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INTRODUCTION

Estimation of genetic parameters for productive and reproductive traits is very vital to the use of artificial selection to achieve maximum genetic improvement in breeding programs (Akanno and Ibe, 2006, Adeleke *et al.*, 2011, Elamin *et al.*, 2012). Accurate knowledge of both environmental and genetic parameters among performance traits are important to establish a sound breeding program and to achieve optimum combinations of body weight and good conformation for maximum economic returns (Khalil *et al.*, 1987, Okoro *et al.*, 2008, Elamin *et al.*, 2012). Rabbit producers and breeders are interested in the relationship that exists between body weight and linear traits because this information would tell something about rabbit feed efficiency and production performance (Okoro *et al.*, 2010). Genetic evaluation and improvement of rabbit in tropical Africa will enhance its contribution to animal protein requirement (Fayeye and Ayorinde, 2003).

This study was aimed at estimating the phenotypic, genetic and environmental correlations between body weight some body size parameters in Nigerian mixed-breed rabbits.

MATERIALS AND METHODS

The study was carried out at the Department of Animal Production, University of Ilorin. Ilorin is located between the rainforest of the Southwest and Savannah grassland of Northern Nigeria. Ilorin is located on latitude 8° 30' 0" North and longitude 4° 33' 0" East on an altitude of 305m, 1001' above sea level. Its annual rainfall, relative humidity and day temperature are 600-1200 mm, 65-80% and 33-37° C, respectively.

Forty (40) weaner rabbits (4-6 weeks of age) of mixed breeds and sexes were assessed for body weight and body size parameters over a period of 8 weeks. The weaner rabbits were fed *ad libitum* on commercial growers' mash (16% crude protein). The mash feed was supplemented with rice bran to improve kits' fibre supply. Water was also provided *ad libitum*. Routine management and health practices were carried out. Morphometric parameters measured were ear length, body girth, body length, head to shoulder, shoulder to tail and length of leg. Body weight (BW) measured in grams using a triple beam balance in the morning before feeding the animals. Body girth (BG) was measured as the circumference of the rabbit kit below the fore arms and head to shoulder (HS) was measured as the length between the forehead and the neck bone. Length of leg (LL) was from the point where the leg joins the body to the foot. Shoulder to tail (ST) was measured as the distance from the shoulder to the tip of tail. Ear length (EL) was obtained as the distance between the tip of the ear and its point of attachment to the body. Body length (BL) was measured as the distance from the forehead to the tail end. All these body measurements were taken using metric tape.

Mean values for body weights and morphometric parameters were subjected to the Least Square Maximum Likelihood Computer program (Harvey, 1990) to obtain the variances used in estimating the phenotype, genetic and environmental correlations between the body weights and body size parameters.

RESULTS AND DISCUSSION

Table 1 shows the body weights and morphometric parameters of weaner rabbits over a period of 8 weeks. Body weight measurements increased from 123±43g in week 1 to 360±66g in week 8.

Table 1: Mean Body weights and Body size parameters

Parameters	Weeks							
	1	2	3	4	5	6	7	8
BW (g)	123±43	166±61	210±69	230±80	287±02	322±107	367±124	360±66
EL(cm)	2.7±0.9	4.5±1.3	5.8±1.8	6.4±1.1	7.2±1.2	7.6±1.1	8.4±1.2	8.5±1.8
BG(cm)	7.3±1.76	10.0±2.4	10.9±3.0	12.2±2.0	13.6±1.7	14.3±2.0	14.8±2.2	14.8±1.8
BL(cm)	16.5±3.0	19.5±3.1	20.3±4.6	23.4±2.9	24.4±4.6	26.2±3.9	26.8±5.5	26.6±3.2
HS(cm)	4.7±1.6	5.9±1.2	6.9±2.4	7.6±2.1	8.2±2.0	8.5±1.4	9.2±1.6	9.7±1.6
ST(cm)	12.3±2.9	15.7±2.9	16.9±3.1	18.8±3.4	20.1±3.9	21.7±3.5	22.9±4.0	23.1±2.9
LL(cm)	6.9±1.5	8.7±1.6	9.6±2.2	11.0±1.8	12.7±1.8	12.8±1.6	14.0±1.6	14.1±1.3

BW, BL, LL, HS, ST, BG, and EL represent Body Weight, Body Length, Length of Leg, Head to Shoulder, Shoulder to Tail, Body Girth and Ear Length, respectively.

Morphometric measurements (BG, HS, LL, ST, EL and BL) also increased asymmetrically with body weight and age. Tables 2 and 3 show the values of the phenotypic correlations (r_P) between body weight and morphometric measurements at 1 and 2 weeks, and at 7 and 8 weeks, respectively. The phenotypic correlations between body weight and all the morphometric parameters were generally positive in weeks 1 (0.26-0.90), 2 (0.51-0.72), 7 (0.66-0.80) and 8 (0.45-0.81) except for the r_P between BW and BL (-0.11) in week 1.

LL was the most consistently phenotypically correlated with BW in weeks 1 and 2 while HS was the most consistently phenotypically correlated trait with BW in weeks 7 and 8. Phenotypic correlations among the six morphometric parameters were generally positive in this study. Genetic correlations (r_G) between body weight and body size parameters were shown in Tables 4 and 5.

Genetic correlations between body weight and all the morphometric parameters were highly positive in weeks 1 (0.84-0.98) and 2 (0.35-0.85) except for BG (0.21) in week 2. ST, HS and LL were more consistently genotypically correlated with body weight in weeks 1 and 2. Genetic correlations between body weight and all the morphometric parameters were generally lower in weeks 7 and 8.

The environmental correlations (r_E) between body weight and morphometric parameters were mostly negative (Tables 6 and 7).

Table 2: Phenotypic Correlations between body weight and body size parameters at weeks 1 and 2

	BW	EL	BG	BL	HS	ST	LL
BW	-	0.37	0.41	-0.11	0.62	0.26	0.79
EL	0.51	-	0.77	0.83	0.65	0.85	0.82
BG	0.57	0.66	-	0.81	0.70	0.84	0.66
BL	0.66	0.73	0.65	-	0.55	0.92	0.74
HS	0.47	0.71	0.63	0.74	-	0.53	0.61
ST	0.72	0.84	0.72	0.92	0.80	-	0.61
LL	0.66	0.58	0.63	0.58	0.46	0.43	-

Upper diagonal represents phenotypic correlations between body weight and body size parameters in week 1 while the lower diagonal represents phenotypic correlations in week 2. BW, BL, LL, HS, ST, BG, and EL represent Body Weight, Body Length, Length of Leg, Head to Shoulder, Shoulder to Tail, Body Girth and Ear Length, respectively.

Table 3: Phenotypic Correlations between body weight and Body size parameters at weeks 7 and 8

	BW	EL	BG	BL	HS	ST	LL
BW	-	0.69	0.79	0.66	0.80	0.77	0.80
EL	0.49	-	1.0	0.84	0.60	0.90	0.74
BG	0.23	0.20	-	0.84	0.60	0.90	0.74
BL	0.70	0.73	0.41	-	0.42	0.89	0.78
HS	0.81	0.63	0.33	0.62	-	0.50	0.48
ST	0.68	0.90	0.32	0.90	0.68	-	0.86
LL	0.45	0.83	0.33	0.71	0.63	0.90	-

Upper diagonal represents phenotypic correlations between body weight and body size parameters in week 7 while the lower diagonal represents phenotypic correlations in week 8. BW, BL, LL, HS, ST, BG, and EL represent Body Weight, Body Length, Length of Leg, Head to Shoulder, Shoulder to Tail, Body Girth and Ear Length, respectively.

Table 4: Genetic correlations (r_G) between body weight and body size parameters at weeks 1 and 2

	BW	EL	BG	BL	HS	ST	LL
BW	-	0.98	0.74	0.84	0.88	0.98	0.79
EL	0.42	-	6.95	0.98	0.90	0.94	0.90
BG	0.21	0.25	-	0.08	0.34	0.02	0.25
BL	0.35	0.94	0.33	-	0.33	0.99	0.13
HS	0.70	0.36	0.56	0.19	-	0.26	0.05
ST	0.85	0.88	0.11	0.58	0.49	-	1.0
LL	0.80	0.36	0.70	0.33	0.40	0.47	-

Upper diagonal represents genetic correlations between body weight and body size parameters at week 1 while the lower diagonal represents genetic correlations in week 2. BW, BL, LL, HS, ST, BG, and EL represent Body Weight, Body Length, Length of Leg, Head to Shoulder, Shoulder to Tail, Body Girth and Ear Length, respectively.

Table 5: Genetic Correlations (r_G) between body weight and Body size parameters at weeks 7 and 8

	BW	EL	BG	BL	HS	ST	LL
BW	-	0.89	0.17	0.30	0.19	0.15	0.06
EL	0.13	-	0.42	0.41	0.28	0.36	0.47
BG	0.37	0.80	-	0.29	0.24	0.14	0.80
BL	0.60	0.85	0.30	-	0.60	0.04	0.36
HS	0.91	0.72	0.18	1.00	-	0.36	0.41
ST	0.44	0.95	0.11	0.86	0.86	-	0.46
LL	0.26	0.11	0.86	0.73	0.73	0.73	-

Upper diagonal represents genetic correlations between body weight and body size parameters at week 7 while the lower diagonal represents genetic correlations at week 8. BW, BL, LL, HS, ST, BG, and EL represent Body Weight, Body Length, Length of Leg, Head to Shoulder, Shoulder to Tail, Body Girth and Ear Length, respectively.

Table 6: Environmental Correlations between body weight and Body size parameters at weeks 1 and 2

	BW	EL	BG	BL	HS	ST	LL
BW	-	0.70	-	0.61	-	0.81	-
EL	0.20	-	0.56	-	-	-	-
BG	0.18	0.36	-	0.27	0.09	-	0.67
BL	0.71	0.80	0.57	-	0.03	0.02	0.02
HS	0.23	0.49	0.38	0.58	-	-	0.22
ST	0.75	0.80	0.52	0.94	0.56	-	0.97
LL	0.45	0.31	0.40	0.38	0.78	0.43	-

Upper diagonal represents environmental correlations between body weight and body size parameters at week 1 while the lower diagonal represents environmental correlations in week 2. BW, BL, LL, HS, ST, BG, and EL represent Body Weight, Body Length, Length of Leg, Head to Shoulder, Shoulder to Tail, Body Girth and Ear Length, respectively.

Table 7: Environmental Correlations between body weight and Body size parameters at weeks 7 and 8

	BW	EL	BG	BL	HS	ST	LL
BW	-	-0.81	0.73	-0.33	-0.86	-0.20	-0.68
EL	0.40	-	0.91	0.75	0.53	0.85	0.28
BG	0.60	0.02	-	0.60	0.11	0.71	0.72
BL	-0.43	-0.90	-0.37	-	0.83	0.84	0.05
HS	-0.04	-0.90	-0.37	-0.36	-	0.94	0.19
ST	-0.18	0.10	0.60	-0.34	1.0	-	0.17
LL	-0.03	-0.51	0.80	-0.50	-0.86	-0.12	-

Upper diagonal represents environmental correlations between body weight and body size parameters at week 7 while the lower diagonal represents environmental correlations in week 8. BW, BL, LL, HS, ST, BG, and EL represent Body Weight, Body Length, Length of Leg, Head to Shoulder, Shoulder to Tail, Body Girth and Ear Length, respectively.

The asymmetric increase in body weight and morphometric parameters with age of weaner rabbits in this study agreed with the submission of Okoro *et al.* (2008) who stated that growth in Chinchilla rabbit with age is asymmetrical with other body parts. The high phenotypic correlations between body weight and morphometric traits like HS, ST and LL in this study suggest that these linear measurements can be used to develop simple or multiple regression equations for predicting body weight of rabbit. The present results agreed with the views of Abdullah *et al.* (2003) who reported high and positive genetic correlation between body weights and linear measurements. The high genetic correlations between early body weight measurements and morphometric traits like HS, ST and LL suggest that genes that contribute additively to body weights also additively influence these morphometric traits at this stage of the animal's life. In general, estimates of genetic correlation vary depending on such factors as traits of interest, population size and strains of rabbit used for the study (Mgheni and Christensen, 1985, de Rochambeau *et al.*, 1989, Garcia and Baselga, 2002, Sánchez *et al.*, 2006, Elamin *et al.*, 2012). For instance, Elamin *et al.* (2012) obtained highly positive genetic correlations between body weights and morphometric traits like length of fore limb, hind limb, thigh girth, tail length, and abdominal circumference of Sudanese rabbit. The authors however obtained low positive genetic correlations between body weight and body length. In another study, Sánchez *et al.* (2006) found very low genetic and environmental correlations between prolificacy and functional longevity in a population selected for litter size at weaning and concluded that longevity and litter size are not antagonistic objectives in breeding programmes.

The highly negative environmental correlations between body weight measurements and most morphometric traits suggest that non-genetic factors that help to improve body weight may invariably have a negative influence on these morphometric traits. The negative environmental correlation obtained in the present study agreed with the report of Sorensen *et al.* (2001) who obtained negative environmental correlation between kit birth weight and litter size (at birth and weaning) and between litter weight at weaning and mortality using litter records obtained from Danish white rabbit. However, Garcia and Baselga (2002) obtained environmental correlation values of 0.599, 1.000 and 0.879 between litter size at weaning and average daily gain, weight at slaughter and weight at weaning in rabbit line selected for litter size at weaning for 21 generations.

CONCLUSION

Rabbit kits can be selected for body weight using early morphometric measurement. The high genetic correlations between morphometric traits like ST, HS and LL with body weight suggests that they can be used to achieve early selection for body weight in the investigated local population of rabbit.

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