THE PERFORMANCE OF MONGREL RABBITS IN A TROPICAL ENVIRONMENT

Abstract

A total of sixty progenies were used to evaluate growth traits comprising body weight and linear body parameters in mongrel rabbits, estimate phenotypic correlations among growth traits, and develop regression models to predict body weight using linear body measurements. Body weight and linear body measurements comprising; Ear length, Heart girth, Body length, Fore-limb, Hind limb, and Tail length were taken from 8 weeks to 16 weeks of age.

Results showed that age exerted ($P < 0.05$) significant influence on all growth traits. Heart girth (HG) had a very high association with body weight at weeks 8 to 10 while body length (BL) recorded a very high association from weeks 8 to 16 making them good traits for selection in the improvement of mongrel rabbits. A positive and strong association was observed between body weight and all linear body parameters throughout the study. This implies that an improvement in any of the linear parameters will bring about an improvement in body weight and vice versa. Body weight was significantly predicted using linear body measurements with a high to medium degree of validity. Higher validity was observed in the multiple models when more traits were fitted into the prediction equation.

Keywords: mongrel, growth performance phenotypic correlations, body weight prediction.

Introduction

Nigeria alongside several nations in sub-Saharan Africa is faced with food insecurity and undernourishment. FAO (2020) reported that though food insecurity is a worldwide issue, it is in the increase in sub-Saharan Africa. FAOSTAT (2019) observed that Nigeria's per capita food supply of animal sources which are superior protein sources is 8 litres of milk, 9kg of meat, and 3.5kg of eggs per year with a consumption level of milk and meat lower than the continental averages of 44 litres and 19kg respectively. Furthermore, the increasing population and urbanization of Nigeria aggravate the existing problem (FAO 2017).

Livestock farming provides a means of improving food insecurity and insufficient animal protein in Nigeria (Ayeni *et al*., 2023). Proteins from livestock that are not readily considered in animal husbandry are being explored (Obasi *et al*., 2019). Domestic rabbits fall in this category, and their advantage is due to their; fast growth rate, ability to convert 20% forage to meat, short gestation period, high prolificacy, high protein level (20.8- 21.3 %), rich in vitamins and minerals, low in sodium, fat, and cholesterol, making it of high nutritive value (Rotimi and Ati, 2020; Sanah *et al*., 2022; Siddiqui *et al*., 2023). Growth in all animals is a complex process controlled by both genetic and non-genetic factors. Although the growth performance of an animal is a phenotypic attribute influenced by the environment, to a large extent however, it is a manifestation of the genetic constitution of the animal (Oleforuh-Okoleh *et al*., 2017).

Growth performance and body conformation traits are important parameters in assessing the potential of genetic improvement and development of mongrel rabbits to enhance their contribution to the much needed animal protein in Nigeria (Adeoluwa and Adebayo, 2020). Morphological variation within species is of great biological interest both as a descriptive and

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This study investigates the growth performance and linear body measurements of mongrel rabbits raised under tropical conditions, providing empirical evidence for their viability as a sustainable protein source in Nigeria.

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They have a short generation interval and the ability to thrive on diverse feed resources, making them an attractive option for smallholder and commercial farming systems (Lebas *et al*., 1997). Among rabbit breeds, mongrel rabbits—characterized by their mixed genetic background—are increasingly considered in tropical regions due to their presumed adaptability and resilience to environmental stressors (Hassan *et al*., 2020).

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Commented [U7]: The tropical environment, while conducive to agriculture, presents significant challenges for livestock production, particularly due to high ambient temperatures, humidity, and seasonal variability (Marai *et al*., 2001). Heat stress, a prominent factor in tropical climates, disrupts thermoregulation, leading to reduced growth performance, decreased fertility, and compromised animal welfare (Rashwan & Marai, 2000).

Commented [U8]: While commercial rabbit breeds such as New Zealand White and Californian have been extensively studied, there is limited information on the performance of mongrel rabbits, which may harbor genetic advantages from hybrid vigor (heterosis) that enhance their adaptability to harsh environments (Ajayi *et al*., 2021). Mongrel rabbits could exhibit better resilience to tropical stressors, but this hypothesis requires empirical validation.

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Commented [U10]: Agree and add this as the citation analytical tool (Hallgrímsson *et al*., 2011). Sexual dimorphism on morphological traits is important in descriptive studies to characterise population composition and evaluate the genetic variation within and between populations of rabbits (Lukefahr and Cheeke, 1991; Lebas *et al*., 1997; Akinola and Onwuka, 2016). Thus the knowledge obtained will be essential in planning breeding programmes and in adopting breeding strategies. It will also be essential in assessing growth rate of mongrel rabbits.

Correlations express the relationships between phenotypic values of the animals, which could be seen in the performance of the animals.The knowledge of the relationships between body weight and growth traits (correlation) is used by breeders in selecting animals as breeding stock and for predicting body weight (Udoh and Udofot, 2016). Obasi *et al*. (2019) reported positive and significant phenotypic correlations between linear body measurements and body weight indicating that an improvement in one trait would lead to a corresponding improvement in the other provided environmental influence is excluded.

MATERIALS AND METHODS

A total of 16 mature mongrel rabbits comprising of 4 males and 12 females were purchased from a reliable rabbit vendor within the State to reproduce progenies for the research. Rabbits were housed individually in three tier wooden hutches of 60 cm x 60 cm and 60 cm from the ground. The hutches were thoroughly washed with detergent and disinfected a week to the arrival of the rabbits. Rabbits were flushed qualitatively a week to mating and then mated at the ratio of 3:1 female to male. Tag numbers were assigned to each hutch and each rabbit was systematically ear numbered with permanent marker for easy identification. Concrete drinkers and feeders were provided. Rabbits were fed *ad libitum* with grower's mash (top feed) and supplemented with forages such as *Centrosema pubescens*, *Pannicum maximum* as suggested by Obasi *et al*., (2019). Clean water was provided daily. Matured rabbits and rabbits at weaning were given Ivomec injections against endo-parasites and ecto-parasites. Kitten were sexed and weaned at the 8th week. Prophylactic medications were administered to weaning rabbits against prevalent rabbit infections such as coccidiosis, mucoid enteritis, pasteurellosis, etc. Multivitamins were administered in drinking water to boost appetite.

DATA COLLECTION

The following data were collected:

1. Body weight of the kittens was measured weekly using a sensitive scale weighing balance (top loading pan scale of 20 kg capacity with 0.01 kg accuracy) and recorded in (g) from 8 weeks to 16 weeks.
2. Linear body measurements comprising of:

a) Body length: length between the neck region to the base of the tail (cm).
b) Heart girth: body circumference of chest region (cm).
c) Length of forelimb: length from the base of ulna bone to the tip of the feet (cm).
d) Length of hind limb: length from the base of the pelvic bone to the tip of the feet (cm).
e) Tail length: length from the base to the tip of tail (cm).
f) Ear length: length from the base to the tip of ear (cm); measured weekly from 8 weeks to 16 weeks using tailor's tape. All measurements were taken in the morning before feeding and by the same person to avoid variations.

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Location (Author try writing as follow)

The experiment was carried out at the Rabbit Unit of the {state as applied to this current study the University or Institute/place), (State where it was carried out), Nigeria (If what the Author wrote in 'Introduction' are to be follow; please Nigeria had different Geo-ecological zone as a Tropical country). The farm is located in the tropical ___(the dash should be stated e,g Rain forest, Mangrove swamp, etc.) vegetation zone of ___ (which part e.g Southern, Northern, etc.) Nigeria lying between longitude (State as applicable to your current study) and latitude (also state as applicable here e.g $5^0$45' and $7^0$34'N) with altitude of (State here e.g 162m), temperature at maximum was about (State here e.g 30^0 C and minimum of 24^0 C). Annual rainfall is about (State here e.g 2300 mm) (Citation here please). The state is bounded in the North by Kogi State, South by Delta state, East by Anambra state and West by Ondo state.

Experimental Animals and Management

A total of (please put the specific numbers of the growing progenies of the 4 males and 12 females as breeder stock in this current study) of 8 weeks (Weaning age) mongrel rabbits of (State the sex or if mixed sex) were used for this experiment. Animals were acclimatized for (State of days or week(s)) before the commencement of the experiment during which, they were observed for any clinical abnormalities. Rabbits were housed individually in three-tier wooden hutches of 60 cm x 60 cm and 60 cm from the ground. The hutches were thoroughly washed with detergent and disinfected a week before the arrival of the rabbits. Tag numbers were assigned to each hutch and each rabbit was systematically ear numbered with a permanent marker for easy identification. Concrete drinkers and feeders were provided. Rabbits were fed *ad libitum* with grower's mash (top feed) and supplemented with forages such as *Centrosema pubescens*, and *Pannicum maximum* as suggested by Obasi *et al*., (2019). Clean water was provided daily.

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EXPERIMENTAL DESIGN

Data collected were subjected to analysis of variance in CRD using SPSS, and significant means were separated by DMRT.

The general linear model for the experiment was: $\mathbf{Y_{ij}=\mu+S_i+e_{ij}}$.

Where;

Y_{ij}…. individual observation

μ …. general mean

S_i …. effect of i^{th} sex (1,2)

e_{ij}…. residual error

RESULTS AND DISCUSSION

Growth pattern of Mongrel rabbits from week 8 to 16

Mongrel rabbit according to the result obtained in this study (table 1) had progressive increase in body weight from 501.83 ± 49.67 g at week 8 to 1300 ± 16.35 g at week 16, this conforms to the report of Onasanya *et al.*, (2017) who observed that body weight proportionately increases with increase in age. Lamptey *et al.*, (2022) also noted that rabbits have progressive growth which is more rapid at the early stage of growth. Linear body parameters also had corresponding increase as body weight was increasing. This agrees with the findings of Sam *et al.*, (2020) who observed that linear body measurements increased as bodyweight increased. The result implies that growth is influenced by age.

The body weight of mongrel rabbits recorded in this study at week 8 (501.83 ± 9.67 g) agrees with Sam *et al.*, (2020) who reported a body weight of 558.50 ± 4.90 g in Chinchilla × New Zealand white but was slightly below 577.51 ±22.18 g obtained by Lamptey *et al.*, (2022) with domestic rabbits. The slight difference could be because of the difference in breeds. Body weight of mongrel rabbits 896.92 ± 13.05 g obtained at week 12 of this research is in line with 873.30 ± 42.23 g obtained by Onasanya *et al.*, (2017) with California white x New Zealand white rabbits, 853.33 ± 30.70 g obtained by Sam *et al.*, (2020) with New Zealand white x Chinchilla rabbits and 890 ± 0.01 g obtained by Rotimi (2022) with New Zealand white x Chinchilla rabbits.

Body length of mongrel rabbits recorded in this study at week 8 (30.60±0.18 cm) is lower than 34.95 ± 4.42 cm obtained by Ologbose *et al*., (2017) but higher than 17.12 ± 1.06 cm and 18.86 ± 0.24 cm obtained by Sam *et al.*, (2020). 35.38 ± 0.18 cm obtained at 12 week of this study is lower than 38.8 ± 2.89 cm reported by Ologbose *et al*., (2017). Body length obtained in the other weeks of this study is likewise, higher than those obtained by other authors, this may be as a result of the difference in breeds used and the environment. Sam *et al.*, (2020); and Adamu *et al.*, (2021) observed that variation of some morphometric traits among different genotypic groups could be attributed to the influence of genetic makeup on growth rate and body weight. Ear length value obtained in this study, 8.3 ± 0.06 – 10.63 ± 0.05 cm is in line with the values obtained by Onasanya *et al.*, (2017), Anya *et al.*, (2018), Rotimi (2022) and Sam *et al.*, (2020). All working with different breeds rabbits, this might imply that ear length of rabbits have same pattern of growth across the breeds. Heart girth of mongrel rabbits observed in this study at week 8; 16.76 ± 0.13 cm is lower than 18.05 ± 1.60 cm obtained by Ologbose *et al*., (2017), 19.42 ± 0.81 cm and 20.79 ± 0.47 cm obtained by Sam *et al.*, (2020). The difference could be because of the difference in breeds and the environment. However, 21.10 ± 0.14 obtained at week 12 is in line with 20.68 ± 2.76 cm obtained by Ologbose *et al*., (2017) but slightly higher than 19.39 ± 0.11 cm obtained by Rotimi (2022). Also, 20.28 – 22.25 cm obtained by Anya *et al.* (2018) in matured rabbits aligns with 16.76 ± 0.13 – 24.88 ± 0.20 cm range obtained in this study. Fore limb value which ranged from 10.88 ± 0.06 – 14.74 ± 0.10 cm was lower than 15.00 ± 2.00 – 17.30 ± 1.86 cm obtained by Ologbose *et al*., (2017) but in line with 12.73- 13.55 reported by Anya *et al.*, (2018) in matured rabbits.

Hind limb value reported in this study was slightly lower than that of Ologbose *et al*., (2017) but in line with Anya *et al.*, (2018). Tail length obtained was lower than that of Onasanya *et al.*, (2017) but in line with Anya *et al.*, (2018).

Table 1: Body weight and linear body measurements for week 8, 10, 12, 14 and 16

	Mean ± SEM				
	Week 8	Week 10	Week 12	Week 14	Week 16
Body Weight	501.83±9.67 [e]	684.67±10.95 [d]	896.92±13.05 [c]	1088.67±15.32 [b]	1300±16.35[a]
Ear Length	8.36±0.06[e]	8.85±0.58 [d]	9.63±0.06 [c]	10.13±0.05 [b]	10.62±0.05 [a]
Heart Girth	16.76±0.13[e]	18.41±0.13 [d]	21.10±0.14 [c]	22.88±0.16 [b]	24.88±0.20 [a]
Body Length	30.60±0.18 [e]	32.88±0.17 [d]	35.38±0.18 [c]	37.36±0.18 [b]	39.89±0.24 [a]
Fore limb	10.88±0.06 [e]	11.66±0.07 [d]	12.74±0.89 [c]	13.69±0.08 [b]	14.74±0.10 [a]
Hind Limb	15.47±0.10 [e]	16.70±0.10 [d]	18.36±0.10 [c]	19.89±0.13 [b]	21.42±0.14 [a]
Tail length	6.66±0.06 [e]	7.33±0.52 [d]	7.98±0.57 [c]	8.49±0.06 [b]	8.98±0.06 [a]

a,b,c = means in a row within a parameter with different superscripts are significantly (p<0.05) different from each other.

Average Daily Gains in Body weight and linear body measurements of Mongrel Rabbits

The average daily gains of mongrel rabbit without recourse to sex is presented in table 2. There were gains in body weight and linear body measurements throughout the period of this study from week 8 to week 16. The average daily body weight gain obtained in this study, which ranged from 13.06 - 15.16 g, is lower than 37.84 - 40.36 g obtained by El Sawy *et al.*, (2023) with New Zealand rabbits, this could be attributed to the difference in breeds and age of rabbits used in this study. However, the range of values agrees with Idowu *et al*, (2022) who obtained a range of 13.02 - 16.21 g/d in mixed breed of rabbits at week 7 to week 10. The result also aligns with the report of Al-Amin *et al.*, (2019) who obtained an average body weight of New Zealand rabbits at 8-9 weeks to range from 10.56 - 20.20 g. Age had significant (p<0.05) effect on the body weight gains and gains in linear body measurements obtained in this study. This implies that the animals gained weight with age.

Table 2 Average Daily Gain of Mongrel Rabbit

Mean ± SEM

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The growth performance and linear body measurements of mongrel rabbits across five different age intervals (week 8, 10, 12, 14, and 16) are summarized in Table 1. There was a consistent and significant increase ($p < 0.05$) in all parameters measured as the rabbits aged. Body weight significantly ($p < 0.05$) increased from 501.83 ± 9.67 g at week 8 to 1300 ± 16.35 g at week 16. This conforms to the report of Onasanya *et al.*, (2017) who observed that body weight proportionately increases with an increase in age. Lamptey *et al.*, (2022) also noted that rabbits have progressive growth which is more rapid at the early stage of growth. Similarly, linear body measurements followed a progressive and significant ($p < 0.05$) upward trend across the weeks. This agrees with the findings of Sam *et al.*, (2020) who observed that linear body measurements increased as body weight increased. The result implies that growth is influenced by age. Ear length increased from 8.36 ± 0.06 cm at week 8 to 10.62 ± 0.05 cm at week 16. Heart girth expanded steadily from 16.76 ± 0.13 cm at week 8 to 24.88 ± 0.20 cm at week 16, indicating a proportional increase in body mass.
Body length rose from 30.60 ± 0.18 cm at week 8 to 39.89 ± 0.24 cm at week 16. This is lower than 34.95 ± 4.42 cm obtained by Ologbose *et al.*, (2017) but higher than 17.12 ± 1.06 cm and 18.86 ± 0.24 cm obtained by Sam *et al.*, (2020). Whilst the forelimb and hind limb lengths increased from 10.88 ± 0.06 cm and 15.47 ± 0.10 cm at week 8 to 14.74 ± 0.10 cm and 21.42 ± 0.14 cm, respectively, at week 16. Tail length also exhibited significant growth, increasing from 6.66 ± 0.06 cm at week 8 to 8.98 ± 0.06 cm at week 16.
The consistent increases in these parameters align with previous findings, where body weight and linear measurements significantly correlate with age in growing rabbits (Yakubu et al., 2010). The significant increments observed in heart girth, body length, and limb measurements suggest enhanced skeletal and muscular development over time, critical for genetic improvement programs and meat production.
The increase in ear length could be linked to physiological adaptations to thermoregulation in rabbits, as previously noted by Etim et al. (2014). Additionally, the steady rise in tail length and limb measurements is consistent with findings by Oke et al. (2018), who emphasized the role of these traits in evaluating growth performance and body conformation.
This progressive growth pattern highlights the potential of rabbits for improving animal protein availability, particularly in regions like Nigeria, where animal protein deficiency is prevalent (Lebas et al., 1997). The observed trends also provide a foundation for further genetic selection and breeding strategies to enhance rabbit production efficiency.

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The Average Daily Gain (ADG) of mongrel rabbits for various body parameters during different age intervals (Weeks 8–10, 10–12, 12–14, and 14–16) is presented in Table 2. The findings highlight significant differences ($p < 0.05$) across the measured parameters within each growth phase.
The body weight showed a significant increase from Week 8–10 (13.06 ± 0.39 g) to Week 10–12 (15.16 ± 0.48 g) before slightly declining during Week 12–14 (13.83 ± 0.54 g) and then rising again during Week 14–16 (15.10 ± 0.62 g). This pattern indicates growth spurts influenced by environmental and nutritional factors, as described by Nwakalor et al. (2017). The observed fluctuations ...

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Parameters	Week 8 – 10	Week 10- 12	Week 12-14	Week 14 – 16
Body Weight	13.06±0.39^{b}	15.16±0.48^{a}	13.83±0.54^{ab}	15.10±0.62^{a}
Ear Length	0.04±0^{b}	0.06±0^{a}	0.04±0.01^{b}	0.04±0^{b}
Heart Girth	0.12±0.01^{c}	0.19±0.01^{a}	0.13±0.03^{ab}	0.14±0.16^{b}
Body Length	0.16±0.01^{ab}	0.18±0.01^{a}	0.14±0.04^{b}	0.18±0.01^{a}
Fore limb	0.06±0^{b}	0.08±0 ^{a}	0.07±0.02^{ab}	0.08±0.01^{a}
Hind Limb	0.09±0^{b}	0.12±0^{a}	0.11±0.02^{a}	0.11±0.01^{a}
Tail length	0.05±0^{a}	0.05±0^{a}	0.04±0.01^{b}	0.04±0^{b}

a b c = means in a row within a parameter with different superscripts are significantly different

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Phenotypic Correlations between Body Weight and Linear Body Measurements of Mongrel Rabbit

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Mongrel rabbits recoded positive and strong association between body weight and linear body measurements all through the period of this study (table 3-5). Ologose *et al.* (2017), Obasi *et al.* (2019) and Sam *et al.* (2020) all recorded positive association between body weight (BW) and linear body measurement (LBM). The highest phenotypic correlation between body weight and linear body measurements at weeks 8 was obtained between body weight (BW) and heart girth (HG- 0.752) followed by body weight and body length (BL- 0.664). Ologose *et al.* (2017) and Sam *et al.* (2020) observed that heart girth and body length had the highest association with body weight at week 8. The strong association recorded between BW and (HG and BL) indicates that HG and BL can be used to predict BW at 8 weeks of age and also selected for improvement of growth traits. Phenotypic correlations amongst LBM were all positive at week 8 ranging from very high to low. This implies that all the linear parameters had the same direction of growth though at different rates. The result in this study agrees with that of, Ologose *et al.* (2017), Obasi *et al.* (2019) and Sam *et al.* (2020). The strongest correlation amongst LBM (0.607) was obtained between heart girth and ear length this implies that the selection of one would result in great benefit to the other. While ear length and hind limb had the least correlation, this implies that the selection of one would have the least benefit on the other. Ologose *et al.* (2017) and Sam *et al.* (2020) had a high correlation between heart girth and other morphometric traits implying that an improvement in heart girth will result in a corresponding improvement of other LBM.

At week 10 phenotypic correlation between body weight and linear body measurement observed, were all positive and highly significant ($p<0.01$). Sam *et al.* (2020) also recorded a positive correlation between BW Band LBM at week 10. The highest correlation in this study was obtained between body weight and hind limb (0.672) followed by body weight and body length (0.602) while the least correlation (0.444) was with ear length. LBM all expressed a positive correlations; the strongest association was between body length and heart girth (0.629) while the least was between ear length and tail length (0.260). Ayo-Ajasa *et al.* (2018) reported body length and heart girth to have a high correlation with each other and can be selected for improvement.

At week 12, body weight had a positive and significant correlation ($p<0.01$) with all LBM studied. Obasi *et al.* (2019) equally obtained positive correlation at week 12 of their study. The highest correlation was with body length (0.650) while the least was with ear length (0.440). This implies that body length is the most suitable for selection at week 12. LBM all had positive correlation the strongest was between body length and ear length while the weakest was between ear length and tail length.

The phenotypic correlation between BW and LBM at week 14 was positive and highly significant ($p<0.01$). Body length had the strongest association while heart girth had the weakest. Correlations on LBMs were all positive. Body length and ear length had the strongest association while heart girth and tail length had the weakest.

There was a positive correlation between body weight and linear body measurements at week 16 expect for heart girth and tail length which was negative. A negative correlation signifies that the selection of one for improvement would result in the reduction of the other. Obasi *et al*. (2019) and Sam *et al*. (2020) reported negative correlations among some morphometric traits. The best correlation between BW and LBM was BL while amongst LBM was between BL and HL, implying that body length (BL) if selected for improvement will positively affect all growth traits at week 16.

It is observed that the correlation coefficient in all ages between BW and LBMs was positive; this means that as the LBMs or BW is increasing, a corresponding increase is expressed in the other. This means that as any one linear body measurement or body weight is increasing, a corresponding increase is expressed in the other. The result implies that the improvement of body weight would result in a corresponding improvement of all the linear body measurements. The high and positive phenotypic correlations observed among the linear body measurements indicate a high genetic variation, which supports high selection response. Implying that any of the linear body parameters can be selected for improvement of body weight and that these correlated traits could jointly be selected, such that an improvement in one linear body measurement proportionately leads to simultaneous improvement in the other. This shows that growth in mongrel rabbits is asymmetrical with other parts. It is also indicator that as the rabbit grows all the other parts are growing concurrently.

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Table 3 Phenotypic correlation of body weight and linear body measurement at week 8 (above diagonal) and week 10 (below diagonal)

	BW	EL	HG	BL	FL	HL	TL
BW		0.637**	0.752**	0.664**	0.577**	0.542**	0.554**
EL	0.444**		0.607**	0.509**	0.457**	0.254	0.266*
HG	0.602**	0.443**		0.573**	0.520**	0.489**	0.393**
BL	0.642**	0.500**	0.629**		0.520**	0.501**	0.404**
FL	0.513**	0.514**	0.513**	0.544**		0.377**	0.270*
HL	0.672**	0.374**	0.477**	0.582**	0.458**		0.459**
TL	0.587**	0.260*	0.356**	0.432**	0.416**	0.516**	

BW = body weight, EL = ear length, HG = heart girth, BL = body length, FL = fore limb, HL = hind limb, TL = tail length ** = highly significant P < 0.01 * = significant P < 0.05

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Table 4.Phenotypic correlation of body weight and linear body measurement at week 12 (above diagonal) and week 14 (below diagonal)

	BW	EL	HG	BL	FL	HL	TL
BW		0.440**	0.513**	0.650**	0.634**	0.559**	0.571**
EL	0.500**		0.331**	0.579**	0.350**	0.350**	0.286*
HG	0.353**	0.318*		0.544**	0.290*	0.405**	0.298*
BL	0.667**	0.608**	0.587**		0.559**	0.539**	0.481**
FL	0.499**	0.223	0.364**	0.519**		0.501**	0.504**
HL	0.556**	0.438**	0.313*	0.544**	0.536**		0.521**
TL	0.529**	0.540**	0.169	0.536**	0.341**	0.532**	

BW = body weight, EL = ear length, HG = heart girth, BL = body length, FL = fore limb, HL = hind limb, TL = tail length ** = highly significant P < 0.01 * = significant P < 0.05

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Table 5 Phenotypic correlation of body weight and linear body measurement at week 16

	BW	EL	HG	BL	FL	HL	TL
BW		0.496**	0.236	0.681**	0.679**	0.618**	0.398**
EL			0.182	0.622**	0.418**	0.580**	0.454**
HG				0.459**	0.257*	0.184	-0.005
BL					0.709**	0.717**	0.422**
FL						0.648**	0.463**
HL							0.387**
TL							

BW = body weight, EL = ear length, HG = heart girth, BL = body length, FL = fore limb, HL = hind limb, TL = tail length ** = highly significant P < 0.01 * = significant P < 0.05

Prediction of Growth Traits of Mongrel Rabbits from week 8 to 16

Body weight was significantly (P < 0.05) predictable from linear body measurements obtained in this study for mongrel rabbits without recourse to sex using both simple and multiple regression models (table 6). Prediction was possible since there were high and positive correlations between body weight and LBMs. This agrees with Sam *et al.* (2020) who reported that linear body measurements with high and positive correlation with body weight of rabbits can be used in body weight prediction which is essential in animal improvement. At week 8, heart girth (HG) was the best linear parameter used for prediction it had the highest correlation with body weight and can therefore be selected for genetic improvement. Ologose *et al.* (2017) also observed (HG) to be the most preferred single predictor at week 8. The highest Coefficient of determination (R^2) 57% and 72% in the simple and multiple regression models respectively were obtained at week 8 of this study. This implies that prediction was most reliable at this week. At week 10, Hind limb (HL) was the best linear parameter used with (R^2) 45%. From week 12 to week 16 of this study, Body length (BL) was the best linear parameter for prediction, this implies that BL should be used for weight prediction in older mongrel rabbits. Higher R^2 values were obtained in the multiple regression equations where more linear parameters were used. Indicating that, multiple regression models should be more reliable. Udoh and Udofot (2016) also reported increased reliability of the prediction model when more linear parameters are used for predictions.

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Commented [U34]: Suggestion this should written as Table 6 presents the simple and multiple regression models used to predict the body weight (BW) of mongrel rabbits at weeks 8, 10, 12, 14, and 16. The models incorporate various linear body measurements, including heart girth (HG), body length (BL), hind limb (HL), forelimb (FL), tail length (TL), and ear length (EL). The performance of each model is evaluated using the coefficient of determination (R^2), standard error (S.E.), and statistical significance. Every other Author write-up should follow.

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Table 6 Simple and Multiple Regression models for predicting Body Weight of Mongrels Rabbits for week 8, 10, 12, 14 and 16

Simple Prediction equation	R^2 (%)	S.E	Sig	Multiple prediction equation	R^2 (%)	S.E	Sig
BW = -469.65 + 57.97 HG	57	49.75	**	BW = -953.22 + 30.18 HG + 12.09 BL+ 42.01 TL + 35.84 EL	72	40.80	**
BW = -595.50 + 76.66 HL	45	63.41	**	BW = -967.23 + 42.54 HL + 27.59 HG + 59.21 TL	61	54.41	**
BW = -777.40+ 46.71 BL	42	77.43	**	BW = -1168.76 + 17.43 BL + 46.57 FL + 51.83 TL + 20.97 HG	60	65.97	**
BW = -1026.54 + 56.62 BL	45	89.13	**	BW = -1180.62+ 43.94 BL + 31.56 HL	50	85.50	**
BW = - 579.67 + 47.13 BL	46	93.58	**	BW = - 800.63 + 27.77 BL + 67.39 FL	54	87.35	**

BW = body weight, EL = ear length, HG = heart girth, BL = body length, FL = fore limb, HL = hind limb, TL = tail length, ** = highly significant P < 0.01 * = significant P < 0.05

CONCLUSION

Body weight of Mongrel rabbits increased gradually from week 8 to 16 indicating that age exert influence on the growth of animals. Linear body parameters had corresponding increase with body weight. Significant interactions were observed in some linear body parameters and also in daily gains of linear body parameters. Body weight had positive and strong association with linear body measurements in all ages of this study. Heart girth (HG) had very high association with body weight at week 8 to 10 while, body length (BL) recorded very high association from weeks 8 to 16 making them good traits for selection in the improvement of mongrel rabbits. Positive regression coefficients were obtained from linear body parameters in body weight prediction implying that linear parameters can be used in body weight prediction of mongrel rabbits.

References

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This study highlights the significant potential of mongrel rabbits as a viable livestock species to combat food insecurity and address the persistent insufficiency of animal protein in Nigeria. The growth performance and linear body measurements of mongrel rabbits demonstrated progressive increases with age, underscoring their adaptability and potential for enhanced meat production in tropical environments. Strong phenotypic correlations observed between body weight and linear body measurements suggest that traits such as body length and heart girth are reliable predictors of body weight, making them valuable selection criteria for genetic improvement programs. The findings revealed that mongrel rabbits exhibit a robust capacity for growth and adaptation, attributable to their genetic diversity and hybrid vigor. The observed trends in body conformation traits and their correlation with growth parameters further provide a foundation for strategic breeding programs aimed at improving productivity. Furthermore, the study underscores the need for targeted management practices during critical growth phases to maximize productivity and improve the economic viability of rabbit farming. Future research should explore the genetic basis of growth traits and environmental adaptability in mongrel rabbits. Such studies would offer deeper insights into their potential for selective breeding and broader adoption in livestock production systems.

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