World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(Research Article)

Check for updates

Sexual dimorphism between live body weight and morphological traits at various age categories of African giant rats (*Cricetomys gambianus*) in Ghana

Masahudu Mohammed *, Addison Duodu, Ismail Coffie, Christian Duah, Hussain Mohammed Sako and Yaw Amevor

Department of Animal Science Education, Faculty of Agriculture Education, Akenten Appiah Menka University of Skills Training and Entrepreneurial Development (AAMUSTED), P. O. Box 40, Mampong- Ashanti, Ghana.

World Journal of Advanced Research and Reviews, 2024, 24(02), 538–547

Publication history: Received on 22 September 2024; revised on 02 November 2024; accepted on 04 November 2024

Article DOI: https://doi.org/10.30574/wjarr.2024.24.2.3241

Abstract

The experiment analysed the sex and age effect between live body weight and six morphological traits of forty (20 Bucks and 20 Does) weaned African giant rats (*Cricetomys gambianus*) at age 2 months in captivity. Data collected on live body weight and morphological traits (body length, heart girth, neck circumference, height at withers, tail length, and head length) at various age categories of 4, 8, 12, and 20 weeks selected at random were analysed using the t-test, Pearson's Correlations, and Multiple Linear Regression models embedded in GenStat 11th edition. There were significant differences ($p < 0.05$) in all the recorded traits measured with the males having higher mean values than females throughout the age categories except that there were no significant differences ($p > 0.05$) in body weight, tail length, and body length at 4 weeks old and the body weights at 8 weeks old. Also, the parameters assessed showed highly significant differences ($p < 0.001$) and strong positive correlation coefficients in both sexes with the males showing superiority over their females throughout the age categories. The highest positive correlation coefficients of body weight at all the age categories were observed with heart girth. Highly significant differences ($p < 0.001$) and higher coefficient of determination (R^2) values were found in the males (0.996 to 0.999) than the females (0.981 to 0.998) using the multiple linear regression models. It was concluded that sexual dimorphism between the live body weights and morphological traits exists at various age categories in the African giant rats.

Keywords: African giant rats; Live body weight; Morphological traits; Sexual dimorphism

1. Introduction

Sexual dimorphism is the differences between males and females of a particular species which are crucial for several economically important traits measured such as live body weights and morphological traits in improving livestock including African giant rats. This dimorphism may be due to sex chromosomes [8], and the differences in gonadal hormones such as androgen in males and estrogen in females regulated through the two sexes' differential genetic architecture [27]. Upon the consequences of sexual dimorphism, most breeding stations still assess economically important traits in males and females as pooled for easy genetic evaluation between phenotypes measured. However, selection may increase the effects of sexual dimorphism when it is not taken into account [30]. In Ghana and other tropical countries, wild meat is dominantly the most consumed source of protein for the millions of Indigenous and non-Indigenous communities that fall under the poverty bracket [31]. The most popular wild meats consumed in Ghana are rodents and ungulates. About 73% of the protein comes from wild animals dominated by grasscutters and African Giant Rats [6]. However, in recent decades, the exploitation of wild animals, particularly rodents, including African giant rats, for their meat, has moved from a source of food and income for indigenous folks to a commodity exploited for profit-making by supplying the urban areas. The increase in demand for wild meat has been brought about by increasing

* Corresponding author: Masahudu, Mohammed

population growth [13]. Rodents such as rabbits [3, 25], grasscutters [4, 14, 23, 12], and guinea pigs [1, 5] have been part of the farming system for more than a decade with a lot of work being done to understand the sexual dimorphism between the live body weights and linear body measurements as compared to African giant rats with little information to be used as selection criteria in a breeding program to help improve production, health care, nutrition, marketing of the African giant rats. Suppose sexual dimorphism in the morphological traits and live body weights are established. In that case, local farmers who find it uncomfortable to use the conventional scales due to their inability to read and write will be much more interested and comfortable using the morphological traits to estimate the body weights to improve the African giant rats. This limited information on the sexual dimorphism between the live body weight and morphological traits of the African giant rats in the available literature has led to this research to analyse the sexual dimorphism between live body weight and morphological traits at various age categories to serve as the basis for improving the African giant rats.

2. Material and methods

2.1. Study Area and Management of Animals

The study was conducted at the African Giant Rat Unit Department of Animal Science; Akenten Appiah Minka University of Skills Training and Entrepreneurial Development Mampong Ashanti Campus from May 2022 to February 2023. Mampong lies in the transitional zone between the Guinea savannah zone of the north and the tropical rain forest of the south of Ghana along the Kumasi –Ejura road. The municipality is located 40km North-East and lies between latitude 07°04'north and longitude 01°24'west with an altitude of 457m above sea level. It has an average annual rainfall of 1224mm with a major rainy season from April to July and a minor rainy season from August to November. The dry season occurs from December to March. The vegetation is transitional savanna woodland. Temperatures are generally high with minimum and maximum values of 22.66 °C and 34.26 °C recorded in March and December respectively with an average temperature of 23.7 °C. Humidity is always around 82.26 % [18]. The 2-month-old weaned African Giant Rats (*Cricetomys gambianus*) were purchased from the Ministry of Food and Agriculture Rat Farmers Association in Kumasi. The stock comprised 20 Bucks and 20 Does weighing 250 to 450 grams and 200 to 400 grams respectively. There were no pedigree records of animals at the time of purchase. The experimental animals have large snouts, grey coats, long tails with white tips, cheek pouches, and fancy facial expressions when eating as common characteristics observed when purchased. The males and females were housed singly in the cells of their respective hutchs. The animals were housed in 3-tier wooden cages, each chamber measuring 70 cm x 69 cm x 50 cm. The 3-tier cages were placed in a room roofed with corrugated iron sheets. The wooden cages were partitioned by 2mm diameter wire mesh. The sides and floor of the wooden cages were also covered with wire mesh. Wire mesh was also used to line the exposed surfaces of the wood to prevent gnawing. The roof of each wooden tier cage was slanted and lined with corrugated iron sheets to aid in easy cleaning and drainage of waste. Animals were fed a basal diet of cassava (*Manihot spp*), riped palm fruits (*Elaeis guineensis*), and maize (*Zea mays*) with guinea grass (*Panicum maximum*) as a supplement. Animals were fed twice a day. Feed and water were provided ad libitum for the animals in a concrete and a clay-made troughs respectively. Cleaning of the cages and the house were carried out daily. Feed and water troughs were also cleaned daily, and provided with clean water and fresh feeds. Sick animals were isolated and treated. Routine deworming was done using dried pawpaw seeds or albendazole 25% (Mobedeo Vet, Jodan) mixed with water or feed. De-worming was done every 3 months [4].

2.2. Data collection

The live body weight was measured in grams using a 10 kg digital hanging scale with 1g sensitivity. A metallic rectangular cage was used to restrict the movement of the animals when weighing to obtain precision and avoid injury to the handler. The morphological traits were taken using a graduated plastic 30 cm measuring rule to measure and record the height. At the same time, the length and circumference measurements were done using flexible calibrated tape in centimeters. The following morphological measurements were collected [4];

Body Length (BL): The distance from the nose's tip to the tail's base.

Heart Girth (HG): The distance around the heart or the circumference of the heart.

Height at withers (HW): The distance from a platform or ground where the animal stands freely and upright to the most dorsal point of the withers. It is taken behind the forelimb.

Head length (HL): The distance from the tip of the nose to the 7TH cervical vertebrae of the neck.

Tail length (TL): The distance from the base to the tip of the tail.

Neck circumference (NC): The distance around the middle of the neck.

To avoid intra-individual variations, all measurements were taken by the same person.

2.3. Statistical analysis

Data on live body weights and six morphological traits obtained from both sexes of the African giant rats were subjected to a t-test, Pearson's correlations (r), and multiple linear regression models embedded in GenStat 11th edition to analyse the sexual dimorphism between live body weights and morphological traits at different age groups in the African giant rats. Probability values < 0.05 were taken as a significant level. The Coefficient of determination (R^2) was obtained in the linear regression models to determine the best predictor of live body weight from the morphological traits in both sexes. Pearson's correlation coefficient (denoted by ρ) was used to know how strongly two traits relate. Pearson's correlation coefficients are estimated using the formula below as stated by [16];

$$\rho(X,Y) = \frac{Cov(X,Y)}{\sigma X \cdot \sigma Y}$$

where;

- X and Y= The two separate traits measured on a sample.
- Cov (X and Y) = Covariance of the two traits measured on a sample.
- σX = Standard deviation obtained on trait X.
- σY= Standard deviation obtained on trait Y

The multiple linear regression model used was of the form;

$$Y = \alpha + \beta 1X1 + \beta 2X2 + \beta 3X3 + \cdots + \beta nXn + e$$

where;

- Y = Dependent variable (body weight)
- $X1$ to Xn = Independent variables (BL, NC, HW, HG, HL, and TL),
- α = Intercept,
- $\beta 1$ to βn= Slope of the regression, and
- e = Random error term.

According to [7], the formula of the coefficient of determination is given by;

$$R^2 = 1 - \frac{(RSS)}{(TSS)}$$

where;

- R^2 = Coefficient of Determination
- RSS = Residuals sum of squares
- TSS = Total sum of squares

3. Results

In Table 1; The mean values of live body weights and linear body measurements, including body length, tail length, neck circumference, heart girth, height at withers, and head length in both sexes increased throughout the weeks that measurements were taken with the males outperforming their female counterparts. Significant differences (p < 0.05; p < 0.01) were largely observed throughout the weeks that measurements were taken except in weeks 4 and 8 where no significant differences (p > 0.05) in some of the traits were recorded particularly in body weight, body length, and tail length in weeks 4 and body weight in weeks 8.

Table 1 Sex and Age effect on live body weight and morphological traits in the African giant rats

Weeks	Sex	LBW/g	BL/cm	HG/cm	HL/cm	HW/cm	NC/cm	TL/cm
4	Male	417	24.54	16.17	6.230	7.760	13.18	24.97
	Female	365	22.08	15.12	5.630	7.170	12.04	23.08
	Mean	391	23.31	15.64	5.930	7.465	12.61	24.03
	SEM	96	2.82	0.96	0.255	0.253	0.91	2.95
	PV	0.265	0.081	0.032	<.001	<.001	0.016	0.191
8	Male	587	29.47	17.87	6.670	8.230	14.67	30.24
	Female	510	26.11	16.54	5.920	7.630	13.26	26.68
	Mean	548	27.79	17.20	6.295	7.930	13.96	28.46
	SEM	93	2.73	0.93	0.262	0.326	0.78	2.66
	PV	0.095	0.018	0.007	<.001	0.001	0.001	0.011
12	Male	920	39.49	21.20	7.490	9.040	17.79	39.82
	Female	807	35.26	19.61	6.730	8.280	16.29	35.81
	Mean	864	37.38	20.40	7.110	8.660	17.04	37.82
	SEM	90	2.78	0.90	0.222	0.210	0.61	2.12
	PV	0.016	0.005	0.001	<.001	<.001	<.001	<.001
20	Male	1169	44.61	23.69	8.100	9.620	19.94	45.60
	Female	1030	41.50	21.85	7.290	8.820	18.61	42.69
	Mean	1100	43.05	22.77	7.695	9.220	19.27	44.15
	SEM	90	1.82	0.90	0.218	0.2275	0.54	1.80
	PV	0.004	0.002	<.001	<.001	<.001	<.001	0.003

LBW: Live Body Weight, BL: Body Length, HG: Heart Girth, HL: Head Length, HW: Height at Withers, TL: Length, NC: Neck Circumference, SEM: Standard Error Mean, PV: Probability value, g: grams, cm: cemtimeters.

In Table 2, the correlation coefficients between live body weight and morphological traits were strongly positive and highly significant (p < 0.001) with the males outperforming the females. The highest correlation coefficient among morphological traits was found between heart girth and body length with the males recording a higher value (r = 0.9985) than the females (r = 0.9938). In the males, the lowest correlation coefficient among the morphological traits was found between the tail length and height at withers (r = 0.8572) while that of the females was seen between head length and height at withers (r = 0.8870). The live body weight had the highest correlation coefficient with the heart girth with the males having a higher value (r = 0.9993) than the females (r = 0.9974). The lowest correlation coefficient of live body weight was found with tail length in the males (r = 0.9134) while that of the females was found with the head length (r = 0.9251) at 4 weeks old.

Table 2 Phenotypic correlation coefficients between live body weight and morphological traits (male on top of the diagonal, and female below the diagonal) of African giant rats at 4 weeks.

	LBW/g	BL/cm	HG/cm	HL/cm	HW/cm	TL/cm	NC/cm
LBW/g	1	0.9992***	0.9993***	0.9865***	0.9633***	0.9134***	0.9979***
BL/cm	0.9946***	1	0.9985***	0.9832***	0.9621***	0.9158***	0.9967***
HG/cm	0.9974***	0.9938***	1	0.9827***	0.9548***	0.9121***	0.9977***
HL/cm	0.9251***	0.9176***	0.9368***	1	0.9768***	0.8973***	0.9854***
HW/cm	0.9919***	0.9907***	0.9851***	0.8870***	1	0.8572***	0.9665***
TL/cm	0.9938***	0.9876***	0.9929***	0.9182***	0.9803***	1	0.9121***
NC/cm	0.9443***	0.9303***	0.9369***	0.9053***	0.9308***	0.9353***	1

LBW: Live Body Weight, BL: Body Length, HG: Heart Girth, HL: Head Length, HW: Height at Withers, TL: Tail Length, NC: Neck Circumference, cm: Centimeters, g: Grams, *** = highly significant difference ($p < 0.001$)

In Table 3, the correlation coefficients between live body weight and morphological traits were strongly positive and highly significant ($p < 0.001$) with the males outperforming the females. The highest correlation coefficient among morphological traits was found between the males' heart girth and head length ($r = 0.9945$) while the females were seen between body length and heart girth ($r = 0.9771$). In the males, the lowest correlation coefficient among the morphological traits was found between the neck circumference and head length ($r = 0.8849$). At the same time, that of the females was seen between neck circumference and tail length ($r = 0.8023$). The live body weight had the highest correlation coefficient with the heart girth in both sexes with the males having higher value ($r = 0.9993$) than the females ($r = 0.9913$). The lowest correlation coefficient of live body weight was found with tail length in the males ($r = 0.9021$) while that of the females was found with the head length ($r = 0.8989$) at 8 weeks old.

Table 3 Phenotypic correlation coefficients between live body weight and morphological traits (male on top of the diagonal, and female below the diagonal) of African giant rats at 8 weeks

	LBW/g	BL/cm	HG/cm	HL/cm	HW/cm	TL/cm	NC/cm
LBW/g	1	0.9868***	0.9993***	0.9954***	0.9916***	0.9021***	0.9065***
BL/cm	0.9845***	1	0.9823***	0.9808***	0.9929***	0.9581***	0.9543***
HG/cm	0.9913***	0.9771***	1	0.9945***	0.9875***	0.8915***	0.8970***
HL/cm	0.8989***	0.8835***	0.9297***	1	0.9832***	0.8882***	0.8849***
HW/cm	0.9641***	0.9215***	0.9510***	0.8712***	1	0.9367***	0.9426***
TL/cm	0.9060***	0.8878***	0.8843***	0.9136***	0.9001***	1	0.9908***
NC/cm	0.9226***	0.8848***	0.9452***	0.8976***	0.8776***	0.8023***	1

LBW: Live Body Weight, BL: Body Length, HG: Heart Girth, HL: Head Length, HW: Height at Withers, TL: Tail Length, NC: Neck Circumference, cm: Centimeters, g: Grams, *** = highly significant difference ($p < 0.001$).

In Table 4, the correlation coefficients between live body weight and morphological traits were strongly positive and highly significant ($p < 0.001$) with the males having higher values than the females. The highest correlation coefficient among morphological traits was found between the heart girth and body length with the males ($r = 0.9983$) having a higher value than the female counterparts ($r = 0.9961$). Also, the lowest correlation coefficient among the morphological traits was found between the neck circumference and head length with the males ($r = 0.8096$) recording a higher value than the females (0.7953). The live body weight had the highest correlation coefficient with the heart girth with the males having a higher value ($r = 0.9985$) than the females ($r = 0.9940$). The lowest correlation coefficient of live body weight was found with neck circumference in the males ($r = 0.8107$) while that of the females was found with the tail length ($r = 0.8870$) at 12 weeks.

Table 4 Phenotypic correlation coefficients between live body weight and morphological traits (male on top of the diagonal, and female below the diagonal) of African giant rats at 12 weeks

	LBW/g	**BL/cm**	**HG/cm**	**HL/cm**	**HW/cm**	**TL/cm**	**NC/cm**
LBW/g	1	0.9949***	0.9985***	0.9919***	0.9745***	0.9387***	0.8107***
BL/cm	0.9877***	1	0.9983***	0.9919***	0.9686***	0.9374***	0.8255***
HG/cm	0.9940***	0.9961***	1	0.9923***	0.9721***	0.9340***	0.8100***
HL/cm	0.9862***	0.9765***	0.9852***	1	0.9685***	0.9378***	0.8096***
HW/cm	0.9866***	0.9924***	0.9940***	0.9728***	1	0.9610***	0.8485***
TL/cm	0.8870***	0.8727***	0.8901***	0.9087***	0.8962***	1	0.9456***
NC/cm	0.9388***	0.9529***	0.9370***	0.9398***	0.9160***	0.7953***	1

LBW: Live Body Weight, BL: Body Length, HG: Heart Girth, HL: Head Length, HW: Height at Withers, TL: Tail Length, NC: Neck Circumference, cm: Centimeters, g: Grams, *** = highly significant difference ($p < 0.001$).

In Table 5, the correlation coefficients between live body weight and morphological traits were strongly positive and highly significant ($p < 0.001$) with the males having higher values than the females. In males, the highest correlation coefficient among morphological traits was found between the height at withers and body length (r = 0.9827)) and that of the female was seen between neck circumference and body length (r = 0.9955). The lowest correlation coefficient among the morphological traits was found between the heart girth and tail length (0.7939) in the males while that of the females was between neck circumference and height at withers (0.7860). The live body weight had the highest correlation coefficient with the heart girth with the males having a higher value (r = 0.9989) than the females (r = 0.9944). The lowest correlation coefficient of live body weight was found in tail length in the males (r = 0.8107) while that of the females was found with the height at withers (r = 0.8029) at 20 weeks.

Table 5 Phenotypic correlation coefficients between live body weight and morphological traits (male on top of the diagonal, and female below the diagonal) of African giant rats at 20 weeks

	LBW/g	**BL/cm**	**HG/cm**	**HL/cm**	**HW/cm**	**TL/cm**	**NC/cm**
LBW/g	1	0.9176***	0.9989***	0.8757***	0.9044***	0.7942***	0.8934***
BL/cm	0.9849***	1	0.9090***	0.9470***	0.9628***	0.9269***	0.9339***
HG/cm	0.9944***	0.9891***	1	0.8695***	0.8940***	0.7939***	0.8992***
HL/cm	0.9376***	0.9671***	0.9492***	1	0.9827***	0.8634***	0.8876***
HW/cm	0.8029***	0.8186***	0.8030***	0.8557***	1	0.8466***	0.8765***
TL/cm	0.9931***	0.9080***	0.9933***	0.9628***	0.8248***	1	0.9644***
NC/cm	0.8485***	0.9955***	0.8640***	0.9250***	0.7860***	0.9029***	1

LBW: Live Body Weight, BL: Body Length, HG: Heart Girth, HL: Head Length, HW: Height at Withers, TL: Tail Length, NC: Neck Circumference, cm: Centimeters, g: Grams, *** = highly significant difference ($p < 0.001$).

In Table 6; all the weeks' recorded measurements showed highly significant differences ($p < 0.001$) with the males outperforming the females. The males' R^2 values range from 0.996 to 0.999 representing 99.6 – 99.9% with SEM values ranging from 2.92 to 6.00 while the females' R^2 values range from 0.981 to 0.998 representing 98.1- 99.8% with SEM values ranging from 4.06 to 12.00.

Table 6 Multiple linear regression analysis for predicting live body weight from morphological traits in the African giant rats based on sex and age

Weeks	Sex	Prediction Equations	SEM	P-V	R^2
4	Males	LBW = - 1252 + 5.45BL + 85.3HG + 11.7HL + 35.8HW – 15.7NC + 0.523TL	2.92	< .001	0.999
	Females	LBW = - 1529 – 0.52BL + 41.0HG + 11.1HL + 140.3HW + 5.02NC + 6.85TL	5.76	< . 001	0.996
8	Males	LBW = - 1429 + 6.0BL + 62.5HG + 43.1HL + 59.0HW + 3.4NC – 3.29TL	3.10	< . 001	0.999
	Females	LBW = - 767.3 + 1.37BL + 99.4HG – 120.2HL + 3.4HW + 4.01NC + 8.63TL	4.06	< . 001	0.998
12	Males	LBW = - 1681 – 23.0BL + 157.3HG + 26.7HL – 20.6HW – 1.2NC + 4.6TL	6.00	< . 001	0.996
	Females	LBW = - 3868 – 55.1BL + 166HG – 26HL + 318HW + 60.2NC – 2.33TL	12.10	0.002	0.981
20	Males	LBW= - 1284 + 2.64BL + 102.46HG – 23.7HL + 50.2HW – 36.0NC + 7.34TL	3.62	< . 001	0.999
	Females	LBW= -121 – 4.37BL – 4.8HG – 27.0HL – 4.6HW – 33.89NC + 54TL	4.53	< . 001	0.997

LBW: Live Body Weight, BL: Body Length, HG: Heart Girth, HL: Head Length, HW: Height at Withers, TL: Tail Length, NC: Neck Circumference, SEM: Standard Error Mean, P-V: Probability Value, R^2: Coefficient of Determination

4. Discussions

The significant sex and age effect on live body weight and morphological traits in African giant rats affirms the works of [20], who stated that live body weight and linear body measurements increase with age in rodents. The higher mean values and significant differences ($p < 0.05$; $p < 0.01$) obtained in the males than the females indicate sexual dimorphism in the African giant rats which might be due to the differences in gonadal hormones (androgen in males and estrogen in females) and sex chromosomes (XY-males and XX- females) that the genotype of both sexes may influence [15]. [21], reported that the tail length for matured males was 42 ± 10.6 cm and that of matured females was 41.21 ± 12.30 cm which agrees with the 8 weeks' age category while the body length for matured males was 38.7 ± 8.4 cm and that of matured females was 35.24 ± 9.0 cm which agrees with the 12 weeks' category of the present study. [22], reported that the average head length for the matured males was 6.94 cm which agrees with the 4 weeks' category, and for matured females 6.78 cm which agrees with the 8 weeks' category. In comparison, the average tail length for matured males was 33.80 cm which agrees with the 8-week category, and that of the matured females was 33.20 cm which agrees with the 12-week category of the present study. [22], also reported that the matured mean value of the males' live body weight was 762. 50 ± 67.98g and the matured mean value of the female's live body weight was 697.50 ± 51.05g which did not conform to any of the age categories under consideration in the present study and that may be a result of different environmental conditions such as nutrition, housing, and the associated errors in weighing. Other researchers have also reported similar findings on different species particularly grasscutters [4, 29, 14, 23, 12], guinea pigs [1], rabbits [3], sheep [26], pigs [9], goats [28], who stated that the live body weights and linear body measurements were higher in the males than the females with significant differences ($p < 0.05$). The significant results on the phenotypic correlation between live body weights and some morphological traits in the African giant rats agree with [21], who stated that there was a positive correlation and significant differences ($p < 0.05$) in the live body weight and morphological traits particularly between body length and tail length ($r = 0.0999$) in the African giant rats except that the values obtained in this present study at various age categories were higher in all the weeks that measurements were taken. The strong positive correlation coefficients and higher significant differences ($p < 0.001$) in the present study imply that live body weight could easily be estimated from any of the linear body measurements, especially under village conditions where illiteracy is high making readings on scales difficult for some farmers and in situations where scales are not readily available. The relationships would also be useful as a selection criterion for a breeding program to improve the production, nutrition, and health status of the African giant rats, and increase the profit margins among rural folks. The higher values of the strong positive phenotypic correlation coefficients found in males than the females in this present findings indicate a better accuracy in selecting a particular trait to improve another trait of economic importance in the males than in the female African giant rats. This conforms to other research findings on different species such as grasscutters [4, 29, 14, 23, 12], and sheep [26], who all stated that there were strong positive phenotypic correlation coefficients in the males than the females. Some researchers also on different species disagree with the present study, such as the goat [2], rabbits [25] guinea pigs [5], and quails [10], who all stated that the females have higher positive phenotypic correlation coefficients than their male counterparts. The disagreement may be due to environmental conditions such as age, population, and feeding. The significant finding that heart girth has the highest positive correlation coefficient with live body weight and high significant differences ($p < 0.01$) with the males having higher values than the females across the age categories conform to other researchers in different species particularly grasscutters [4, 29, 14, 12], guinea pigs [1], crossbred rabbits [3], sheep [19], and goat [28], who all stated that heart girth among other linear body measurements have the highest phenotypic correlation coefficient with live body weight with the males outperforming the females. Other researchers on different species that disagree with this current finding are; [9], in the Ashanti black pig who obtained body length as the one with the highest positive correlation coefficient with body weight, and [17], in grasscutters who also obtained head length as the one with the highest positive correlation coefficient with live body weight. This disagreement may be attributed to the differences in environmental variations such as age, sample size, and species. The highest correlation of live body weight with heart girth across the age categories in both sexes was seen in weeks 4 which could be a high genetic association between live body weights and linear body measurements at an early stage of development (weaned) in the African giant rats which conform to the general notion in livestock growth and development [15]. The selection of live body weights of African giant rats immediately after they are weaned at 4 weeks could help forecast better performances of body weight at later ages in the meat industries which agrees with other researchers on different species such as grasscutters [4, 14, 12], guinea fowls [11], and rabbits [3]. The significant result for predicting live body weight from morphological traits in the African giant rats using the multiple linear regression model was possible at higher significant differences ($p < 0.001$) with the males seen as the best predictors of live body weight due to the higher values of R^2 and lower values of SEM observed throughout the weeks that measurements were taken compared to the female counterparts. This assertion agrees with the findings of [4, 29, 12, 14] in grasscutters, [1] in guinea pigs, [26] in sheep, and [24] in goats who stated that the coefficient of determination (R^2) values were higher with high significant differences ($p < 0.001$) in the males than the females. These findings disagree with the work on rabbits by [3], guinea pigs by [5], and goats [2], who stated that the coefficient of determination (R^2) values were higher with significant differences ($p < 0.05$) in the females than their male counterparts. The disagreement may be due to environmental variations such as age, type of species, sample size, and feeding.

5. Conclusion

- In this study, the live body weight and morphological traits measured were higher in the males than the females at the various age categories (4, 8, 12, and 20 weeks) showing sexual dimorphism at all levels of growth in the African giant rats.
- A selection program to improve live body weight will produce a positively strong correlated response in all the morphological traits in the African giant rats at different age groups with the males showing superiority over the females.
- Predicting live body weight from morphological traits using the multiple linear regression models was reliable at different age groups since measured variables had high R^2 values indicating higher accuracy. The higher R^2 values in the males showed better accuracy in using the males to predict body weight from morphological traits than the females.
- This research can be used as a basis for other researchers since there is limited information on the sexual dimorphism between live body weight and morphological traits at various age groups of the African giant rats in captivity

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Abossede, M. L. F., Alex, G. Z., Vidjinnangni, F. G. N. D., & Mahule, S. H.-A. (2019). Determination of body weight from morphometric characteristics of guinea pigs (Cavia porcellus) reared in southern Benin. International Journal of Livestock Production, 10(1), 9–13. https://doi.org/10.5897/IJLP2018.0541

[2] Adeyinka et al., (2006). Relationship of Liveweight and Linear Body Measurement in Two Breeds of Goat of Northern Nigeria. Journal of Animal and Veterinary Advances.

[3] Agaviezor, B., Ologbose, F., & Ajayi, F. (2017). Effect of Breeds, Sex and Age on Interrelationship between Body Weight and Linear Body Measurement in Rabbits. Journal of Fisheries & Livestock Production, 05. https://doi.org/10.4172/2332-2608.1000250

[4] Annor et al., (2011). The genetics of morphological traits in the grasscutter. http://www.lrrd.org/lrrd23/8/Anno23167.htm

[5] Appau, D. O., Duodu, A., Bonsu, F. R. K., Kwenin, W. K. J., Atta Poku, P. S., Amadu, B., & Husein, S. M. A. (2023). Phenotypic characterization of linear body measurements of Guinea pigs (Cavia porcellus) in the middle belt of Ghana. International Journal of Environmental & Agriculture Research, 9(1), 01–10. https://doi.org/10.5281/zenodo.7654160

[6] Asibey, E. O. A. (1977). Expected Effects of Land-use Patterns on Future Supplies of Bushmeat in Africa South of the Sahara. Environmental Conservation, 4(1), 43–49.

[7] BYJUS. (2024). Coefficient of Determination (R-squared)—Definition, Formula & Properties. BYJUS. https://byjus.com/maths/coefficient-of-determination/

[8] Cox, R. (2021). Sexual Size Dimorphism. In T. K. Shackelford & V. A. Weekes-Shackelford (Eds.), Encyclopedia of Evolutionary Psychological Science (pp. 7490–7496). Springer International Publishing. https://doi.org/10.1007/978-3-319-19650-3_1678

[9] Darfour et al. (2010). Predictive abilities of two linear body measurements of live weight of the Ashanti Black Pig. 5, 49–59.

[10] Dudusola, I. O., Adeyemi, E. A., & Oyeromi, O. F. (2020). Prediction of body weight from linear body measurements in Japanese quail. Nigerian Journal of Animal Production, 45(4). https://doi.org/10.51791/njap.v45i4.544

[11] Duodu, A. (2023). Genetic and Phenotypic Correlations between Characteristics in Local Guinea Fowl in Ghana. Asian Journal of Advances in Agricultural Research, 21(4), 1–9. https://doi.org/10.9734/ajaar/2023/v21i4421

[12] Durowaye, A., Salako, A., Osaiyuwu, O., & Fijabi, O. (2021c). Relationship among Liveweight and Body Dimensions of the Greater Cane Rat (Thrynomys swinderianus). 1–9.

[13] Fa, J. E., Nasi, R., & Funk, S. M. (Eds.). (2022). Eating Wild Animals. In Hunting Wildlife in the Tropics and Subtropics (pp. 1–37). Cambridge University Press. https://doi.org/10.1017/9781316338704.002

[14] Hagan, B. A., Nyameasem, J. K., Asafu-Adjaye, A., & Darfour-Oduro, K. (2016). Predicting live weight of grass cutters using their linear body measurements. Livestock Research for Rural Development, 28.

[15] Hutu, I., Oldenbroek, K., & Waaij, L. (2020). Chapter I.5. Livestock growth and development (p. 25). https://doi.org/10.13140/RG.2.2.28612.35207

[16] J. Fernando. (2024). The Correlation Coefficient: What It Is and What It Tells Investors. Investopedia. https://www.investopedia.com/terms/c/correlationcoefficient.asp

[17] Jayeola, O. A., Onadeko, S. A., Ademolu, K. O., & Awofeso, O. M. (2009). Prediction of body weight from body measurements in canerat: Thryonomys swinderianus (Temminck, 1827). Zoologist (The), 7. https://doi.org/10.4314/tzool.v7i1.52079

[18] Mampong Municipal Assembly. (2024). https://mma.gov.gh/

[19] Markos, D., Masho, W., Baye, M., & Bayou, E. (2023). Morphometric traits and stepwise regression of indigenous sheep in southwestern region, Ethiopia. Journal of Agriculture and Food Research, 14, 100666. https://doi.org/10.1016/j.jafr.2023.100666

[20] Nagy, T. R., & Pappas, L. E. (2019). The translation of age-related body composition findings from rodents to humans. European Journal of Clinical Nutrition, 73(2), 172–178. https://doi.org/10.1038/s41430-018-0324-6

[21] Obadiah, B., Dzenda, T., & Happiness, O. I. (2015). Tail allometry of the grasscutter (Thryonomys swinderianus) and African giant pouched rat (Cricetomys gambianus): It's Functional Relevance. World J Zool, 10(2), 112–117.

[22] Olude, A., Idowu, A. O., Mustapha, O., Olopade, J., & Akinloye, A. (2015). Spinal Cord Studies in the African Giant Rat (Cricetomys gambianus, Waterhouse). Nigerian Journal of Physiological Sciences: Official Publication of the Physiological Society of Nigeria, 30, 25–32.

[23] Osaiyuwu, O. H., Akinyemi, M. O., Akindele, O. D., & Ewuola, K. M. (2018). ANALYSIS OF SEXUAL DIMORPHISM IN MORPHOMETRIC VARIABLES OF CANE RAT. Tropical Animal Production Investigations, 21(2), Article 2.

[24] Ouchene et al. (2021). Statistical models based on morphometric traits for live body weight estimation in goats. Agricultural Science and Technology, 13(Volume 13, Issue 2), 134–140. https://doi.org/10.15547/ast.2021.02.022

[25] Rotimi, E. A. (2021). Examination of sexual dimorphism in New-Zealand White × Californian rabbits by morphological traits. Agricultura Tropica et Subtropica, 54(1), 52–56. https://doi.org/10.2478/ats-2021-0006

[26] Sam, I., Usoro, O., & F., U. (2023). Relationship of linear body measurements with live body weight in West African Dwarf sheep raised in Tropical Rainforest of Nigeria. Journal of Animal Science and Veterinary Medicine, 8, 46–51. https://doi.org/10.31248/JASVM2023.365

[27] Tesfay, & et al., M. (2017). Live body weight and linear body measurements of indigenous sheep population in their production system for developing suitable selection criteria in Central Zone of Tigray, Northern Ethiopia. African Journal of Agricultural Research, 12(13), 1087–1095. https://doi.org/10.5897/AJAR2016.11927

[28] Tsegaye, D., Belay, B., & Haile, A. (2013). Linear Body Measurements as Predictor of Body Weight in Hararghe Highland Goats under Farmers Environment: Ethiopia.

[29] Udeh, I., & Okonta, B.-C. O. (2013). Prediction of body weight from body measurements in grass cutters. Tropical Animal Health and Production, 45(6), 1331–1334. https://doi.org/10.1007/s11250-013-0364-9

[30] van der Heide, E., Lourenco, D., Chen, C.-Y., Herring, W., Sapp, R., Moser, D., Tsuruta, S., Masuda, Y., Ducro, B., & Misztal, I. (2016). Sexual dimorphism in livestock species selected for economically important traits. Journal of Animal Science, 94, 3684. https://doi.org/10.2527/jas.2016-0393

[31] Vliet, N., Moreno, J., gómez, J., Zhou, W., Fa, J., Golden, C., Alves, R., Alves, N., & Nasi, R. (2017). Bushmeat and human health: Assessing the Evidence in tropical and sub-tropical forests. 6. https://doi.org/10.15451/ec2017-04-6.3-1-44