Analysis of Weight and Morphometric Characteristics of a General Rat

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***Abstract*: - This study aimed at studying the body weight (BW) and some morphometric traits at birth, 7, 14, 21, 28 and 35 days of a general rat. Sex effect and the various phenotypic correlations between the traits were evaluated. Traits studied were Body Weight (BW), Head Length (HL), Tail Length (TL), Body Length (BL) and Heart Girth (HG). The coefficient of variation for traits studied were generally high to moderate at various age groups but relatively low at 35 days. The coefficient of variation for traits studied was high for body weight at 7, 14, and 21 days and moderate for head length and tail length at various age groups, but relatively low for heart girth. Traits significantly ($p < 0.05$) affected by sex were body weight, tail length, body length and heart girth at birth, and head length at 28 days. Phenotypic correlation between BW and all the other traits studied were highly significant ($p < 0.001$), correlation being higher in younger groups than in older group. Correlation between HL and HG, BL and HG and also between BW and TL at 7, 21 and 35 days respectively were significant at $p < 0.01$. Also the phenotypic correlation of heart girth (HG) with tail length (TL) and body length (BL) at 21 and 28 days respectively, and also between body weight (BW) and tail length (TL) at 35 days were significant at $p < 0.05$. This study reveals that morphometric traits can be use as aids to selection in laboratory albino rat's genetic improvement and also live body weight prediction.**

Keywords: **Morphometric, Rats, Traits, Measurement, Body weight, sex**

I. INTRODUCTION

Laboratory albino rat belong to the Phylum Chordata, Family Rodentia, and Genus *Rattus.* The rat, *Rattus novergicus,*was bred purposely for scientific research. The rat pup, at birth, weighs about 5*g* and is blind, but very active, growing rapidly to 35-50*g* by three weeks. The adult male weighs from 400-500*g* with the female weighing about 100*g*or less (Orheruata, 1991). Size/weight varies markedly between strains. Adults continue to increase very gradually in skeletal size throughout life as the rat's long bone epiphyses do not become completely inactive. Over the years, selection for growth is usually done on the basis of body weight. The decision to use an indirect measurement for selection purposes for growth will depend on the ease of taking the measurements and how these measurements can predict body weight. One of such substitutes is the use of linear measurements (Orheruata, 1991). The different body parts develop at varying rates and these changes determine the shape, conformation and body proportion of the animal at a given time (Olutogun*et al.*, 2003). Linear body measurements could be a means of describing the size and shape of farm animals.(Ibe and Ezekwe, 1994) reported that linear body measurements have been used to characterize breeds, evaluate breed performance and predict live body weight of animal. It is against this background that the study was undertaken with the aim of determining the degree of association between body weight and linear body measurements. An attempt also was made to find out the effect of sex on the interrelationship between body weight and linear body measurements.

Statement of Research Problem

There is little or no information in the literature about the morphometric characters of laboratory rat (*Rattus norvegicus*) and also on the degree of association between its body weight and linear body measurements and the effect of sex on traits.

Aim of the Study

This study aims at determining the degree of association between body weight and linear body measurement in albino rat (*Rattus norvegicus*)

Objectives of the Study

The research has the following objectives:

- To find out the relationship between morphometric characters and body weight of *Rattus norvegicus*.
- To find out whether sex has effect on the body weight and linear body measurement of *Rattus norvegicus*.

Justification

The findings or outcome of this study will establish the degree of association between body weight and linear body measurement in *Rattus norvegicus* and will also tell the effect of sex on the interrelationship between body weight and linear body measurements. This will help farmers and those that breed laboratory rats for scientific investigations in predicting the body weight of the animals by using just a flexible measuring tape.

II. MATERIALS AND METHODS

Study Location

This study was conducted in the biology laboratory, Department of Biological Sciences, Ahmadu Bello University, Zaria which is located on the latitude 11^0 3′N and longitude 7^0 42′E, within the Northern Guinea Savanna Zone of Nigeria and is characterize by distinct rainy (May-October) and dry (November – April) seasons.

Housing and Feeding

Aluminum cages with wire cover and saw dust on the floor were used in the collecting and managing of the rats. On arrival, rats were shared into two separate cages each containing one male and five (5) females, since there mating harem is 1 male to 5 or 6 females. After birth, a female rat was separated from the main cage to a separate cage with her pups (newly borne rats). Rats were kept at room temperature (at 24±2^0C) and relative humidity of 55±10%.Rats were fed with maize offal mixed with commercial pelleted vital feed in the ratio 2: 1 (i.e. 288*g* of the maize chaff and 143g of the vital feed) and tap water was used to mix the feed. The feed were then molded to form a bolus to avoid wastage by the rats' feeding activity before administering. Two (2) bolus of the feed was given to a group of a mating animals 3 times daily while a single bolus was given to a female rat with her pups, depending on the age and number of pups. Water was provided by bottle with a narrow tube, intake was by sipping.

Experimental design

Data were recorded on morphometric characters and body weight of 57 animals, of which 30 were males and 27 females, from birth to 35 days of age. Body weight and linear body measurements on the animals were recorded, at birth, then at 7, 14, 21, 28, and 35 days of age. All body weight was taken by using digital electronic weighing balance in grams. The following morphometric characters were measured in centimeters using measuring board:

- Head length (HL); the distance from the tip of the nose to the last cervical vertebrae
- Tail length (TL); the distance from the base of the tail to the tip
- Body length (BL); the distance from the tip of the nose to the tip of the tail
- The anterior tip of the rat's nose was placed against the top beginning of the measuring board, and standard head length (HL), tail length (TL), and body length (BL) were taken.
- Heart girth (HG); the circumference of the chest at point immediately behind the forelimbs, perpendicular to the body axis was also taken using a flexible measuring tape calibrated in centimeters (cm).

Sexing: Sex was determined using the anogenital distance. Males have a greater anogenital distance than females as well as a larger genital papilla. In neonatal (new born) males, the testis may be visible through the abdominal wall but it is retractable, so it was not used as criterion for sexing. In addition, different colors of indelible markers were used to mark the animals (each with separate mark) from birth to 35 days.

Data collection

Each animal record including animal kid and dam identification, sex age, birth weight, weight at 7 days, 14 days, 21 days, 28 days and 35 days. Body lengths (BL), head length (HL), heart girth (HG) and tail length (TL) were all recorded.

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) using the central linear method, procedure of prog GLM of Statistical Analysis System (SAS) to find out if there is any significant relationship between the parameters, and also correlation coefficient was used to determine the relationship between the traits studied.

III. RESULT AND DISCUSSION

Data were recorded on morphometric characters and body weight of 57 animals. Of these, 30 were males and 27 females. Body weight and linear body measurements on the animals were recorded, at birth, then at 7, 14, 21, 28, and 35 days of age. Two (2) of the animals died before weaning and were both males while tree (3) of the animal died after weaning two of which were females and 1 male. An overview of the number and distribution of the rats across the sex and ages is shown in table I.

The least square means and coefficient of variation of various traits studiedare shown in Table 2. The table shows that, coefficient of variation varied from high to low being high for body weight at various ages, this agrees with the resultsof Hassan *et al.*(2012) in local rabbit of Sudan, moderate for head length and tail length and relatively low for heart girth.

Table 3 shows the sex effect on body weight and linear body measurement. Traits that were significantly affected (at $p > 0.05$) by sex were; body weight, tail length, and body length and heart girth all at birth and head length at 28 days (with males being higher in all the characters).This is also in agreement with the result of (Jacint and Maria, 2000) in black rat, *Rattusrattus.* However, in none of the specimens of each sere offspring evaluated was tail length shorter than head length and body length. Although males were slightly larger than the females in all the traits on the average, there was no significant sexual dimorphism in the various ages studied. This is in agreement with the general trends shown by Western Mediterranean black rat population (Garanjon and Cheylan, 1990, Zamorano 1985)

Table 4 shows the correlation coefficient for traits at birth (above diagonal) and at 7 days (below diagonal). Table 5 shows the correlation coefficient for traits at 14 days (above diagonal) and 21 days (below diagonal). Table 6 also shows

the correlation coefficient of body weight and linear body measurements at 28 days (above diagonal) and 35 days (below diagonal). In general, the phenotypic correlation between body weight and all other traits at various ages were highly significant at $p < 0.001$ with very little moderate correlation at $p < 0.01$ and a single negative correlation between head length and heart girth at 7 days.

In general, the phenotypic correlation between body weight and all the other the traits at various ages of studies were significantly high at $p < 0.001$ with very few moderate correlation at ($p < 0.01$) and at ($p < 0.05$).

These changes might be as a result of nutritional status of the individuals, competition between individuals of a cage, litter size, physiological states of the individual as well as ecological factors.

TABLE 1: Distribution of experimental animals

Age group	Males	Females	Total
At birth	30	27	57
At 7 days	28	27	55
At 14 days	28	27	55
At 21 days	28	27	55
At 28 days	27	25	52
At 35 days	27	25	52

TABLE 2: LEAST SQUARES MEANS AND COEFFICIENT OF VARIATION OF LINEAR MEASUREMENT AT BIRTH, 7, 14, 21, 28 AND 35 DAYS

BWT = body weight, HL = head length, TL = tail length, BL = body length, HG = heart girth, S.E = Standard error, C.V = coefficient of variation

AGE	AT BIRTH		AT 7 DAYS		14 DAYS		21 DAYS		28 DAYS		35 DAYS	
Traits	Mean± S.E	C.V	Mean ± S.E	C.V	Mean ± S.E	C.V	Mean ± S.E	C.V	Mean ± S.E	C.V	Mean ± S.E	C.V
BWT (g)	5.225±0.096	12.434	10.027±0.366	24.815	18.096±0.802	30.819	28.159±1.149	29.579	42.665±1.432	23.943	57.383±1.459	18.465
HL (cm)	1.561±0.021	9.562	2.306±0.039	11.704	2.950±0.032	7.591	3.535±0.050	10.208	3.882±0.048	8.160	4.206±0.052	8.908
TL (cm)	1.480±0.025	11.862	3.046±0.063	14.791	4.858±0.079	9.916	6.904±0.129	12.636	10.312±0.202	13.706	12.867±0.182	9.661
BL (cm)	5.788±0.060	7.150	9.315±0.145	10.854	12.423±0.199	10.583	15.650±0.305	13.274	6.692±0.114	10.968	24.225±0.217	6.223
HG (cm)	2.788±0.029	7.080	3.917±0.075	12.291	4.573±0.089	14.179	5.702±0.090	10.739	21.267±0.321	8.899	7.621±0.088	8.146

TABLE 3: LEAST SQUARE MEANS 0F LINEAR MEASUREMENTS AT BIRTH, 7, 14, 21, 28 AND 35 DAYS (EEFECT OF SEX)

AGE			AT BIRTH		AT 7 DAYS		AT 14 DAYS		AT 21 DAYS		AT 28 DAYS		AT 35 DAYS
Traits	SEX	No	Mean	No	Mean	No	Mean	No	Mean	No	Mean	No	Mean
BW (g)	Male	1	5.44±0.14[a]	1	10.83±0.54	1	18.84±1.19	1	29.29±1.64	1	44.29±2.12	1	58.96±2.175
	Female	2	4.95±0.11[b]	2	9.43±0.49	2	16.75±1.06	2	27.22±1.61	2	41.32±1.87	2	55.77±1.91
HL (cm)	Male	1	1.60±0.03	1	2.36±0.06	1	2.96±0.05	1	3.61±0.08	1	4.00±0.068[a]	1	4.28±0.08
	Female	2	1.52±0.03	2	2.22±0.05	2	2.92±0.04	2	3.45±0.06	2	3.77±0.06[b]	2	4.11±0.07
TL (cm)	Male	1	1.52±0.04[a]	1	3.12±0.09	1	4.91±0.10	1	7.02±0.16	1	10.57±0.29	1	13.11±0.26
	Female	2	1.43±0.03[b]	2	2.94±0.09	2	4.70±0.13	2	6.67±0.20	2	10.13±0.28	2	12.70±0.24
BL (cm)	Male	1	5.91±0.09[a]	1	9.47±0.20	1	12.54±0.29	1	15.94±0.42	1	21.61±0.43	1	24.40±0.34
	Female	2	5.63±0.07[b]	2	0.05±0.21	2	12.09±0.28	2	15.10±0.45	2	21.38±0.48	2	24.15±0.26
HG (cm)	Male	1	2.86±0.04[a]	1	3.98±0.11	1	4.69±0.13	1	5.79±0.13	1	6.71±0.15	1	7.63±0.14
	Female	2	2.71±0.04[b]	2	3.93±0.11	2	4.45±0.12	2	5.69±0.13	2	6.81±0.17	2	7.65±0.11

BW= body weight, HL= head length, TL= tail length, BL= body length, HG= heart girth

Means with different letters are significantly ($p < 0.05$) different

TABLE 4: COEFFICIENT OF CORRELATION OF LINEAR BODY MEASUREMENT AT BIRTH (ABOVE DIAGONAL) AND AT 7 DAYS (BELOW DIAGONAL)

Traits	BW (g)	HL (cm)	TL (cm)	BL (cm)	HG (cm)
BW (g)	1	0.49***	0.47***	0.64***	0.63***
HL (cm)	0.44***	1	0.51***	0.41***	0.23
TL (cm)	0.54	0.83	1	0.59***	0.42**
BL (cm)	0.60	0.83	0.9	1	0.41**
HG (cm)	0.37**	-0.02	0.13	0.03	1

BW = Body weight, HL = Head length, TL = Tail length, BL = Body length, HG = Heart girth

* = P < 0.05, ** = P < 0.01, *** = P< 0.001

TABLE 5: COEFFICIENT OF CORRELATION OF LINEAR BODY MEASUREMENT AT 14 DAYS (ABOVE DIAGONAL) AND AT 21 DAYS (BELOW DIAGONAL)

Traits	BW (g)	HL (cm)	TL (cm)	BL (cm)	HG (cm)
BW (g)	1.00	0.66***	0.75***	0.89***	0.86***
HL (cm)	0.61***	1.00	0.73***	0.72***	0.53***
TL (cm)	0.61***	0.64***	1.00	0.92***	0.55***
BL (cm)	0.69***	0.71**	0.90***	1.00	0.69**
HG (cm)	0.81***	0.37**	0.33*	0.38**	1.00

BW = Body weight, HL = Head length, TL = Tail length, BL = Body length, HG = Heart girth

* = p < 0.05, ** =p < 0.01, *** = p < 0.001

TABLE 6: COEFFICIENT OF CORRELATION OF LINEAR BODY MEASUREMENT AT 28 DAYS (ABOVE DIAGONAL) AND AT 35 DAYS (BELOW DIAGONAL)

Traits	BW (g)	HL (cm)	TL (cm)	BL (cm)	HG (cm)
BW (g)	1	0.53	0.78	0.69	0.78
HL (cm)	0.30*	1	0.7	0.33*	0.30*
TL (cm)	0.37**	0.61	1	0.67	0.57
BL (cm)	0.74	0.32*	0.57	1	0.85
HG (cm)	0.73	0.31*	0.53	0.82	1

BW = Body weight, HL = Head length, TL = Tail length, BL = Body length, HG = Heart girth

* = p < 0.05, ** = p < 0.01, *** = p < 0.001

IV. CONCLUSION AND RECOMMENDATION

It is concluded that morphometric traits, as they were highly correlated with body weight in laboratory rat, *Rattusnorvegicus* can be effective in body weight prediction and genetic selection will be effective in improving morphometric traits.

Sex was found to have significant effect on body weight, tail length, and body length and heart girth at birth and head length at 28 days.

Phenotypic correlation of body weight with the other traits at various age of study was found to be very significant at ($p < 0.001$) level.

Further research on the morphometric traits of laboratory rat Rattus norvegicus should be carried out to improve the various traits

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