

# Age and sex dimorphism of the ratio between body measurements to live weights in Red Sokoto, Sahel and West African Dwarf goats

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Accepted 13 July, 2015

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## ABSTRACT

The study was carried out in Borno, Sokoto and Ogun States. These states were selected because those locations are having close to pure breeds of the goats. Animals used for this study were sampled in the abattoir of Borno, Sokoto and Ogun States when brought for slaughtering either by the owner or by the slaughter man. 900 goats comprising of three hundred Sahel goats from Borno State, three hundred Red Sokoto goats from Sokoto State and three hundred West African Dwarf goats from Ogun State were used for the study made up of fifty males and fifty females distributed in the following age groups <1, 1-2 and 2-3 years. These were evaluated for morphometric characteristics. The pairs of permanent incisors in the dentition of the goat were used to determine age. The following metric characters were measured on each animal: body weight (BW), age, horn length (HL), ear length (EL), shoulder width (SW), neck circumference (NC), body length (BL), withers height (WH), heart girth (HG), pouch girth (PG) and tail Length (TL) along with body weight. Obtained measures were compared to body weight as ratio of measures to body weight and resulting ratio was subjected to analysis of variance using age and sex as classification variables with the SAS software. It was observed that PG had the highest ratio of 4.82, 3.68 and 3.58 respectively for the three breeds of goat. HL showed the least ratio of 0.50, 0.53 and 0.36 for Red Sokoto, Sahel and WAD goats. It follows that higher ratio indicates higher contribution of a given morphometric part to liveweight relative to that of other parts, so that selection could be made on the basis of this ratio. In conclusion, PG in this study consistently indicate high ratio and should be recommended for further studies as a selection factor in breeding and production of goats.

**Keywords:** Sexual dimorphism, body parts ratio, age, sex.

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## INTRODUCTION

The main purpose of animal breeding practices is to improve traits of economic values (Mendes et al., 2005). These traits have close association with explanatory variables such as age, breed and morphological characters. Body weight is an important economic trait in the selection of animals (Yakubu et al., 2011). Body measurements have been used in animals to estimate body weight (Topal and Macit, 2004; Yakubu et al., 2005), especially in rural communities where scales are not readily available. Body measurements have been

used in animals to contrast variation in size and shape (Lanari et al., 2003; Salako, 2006), and to estimate body weight (Slippers et al., 2000; Topal and Macit, 2004). Weight is a very important factor in selection and production of goats. These small ruminants play a major role in the sustenance of rural populations in Nigeria, where the standard of living is predominantly low, and also have a major cultural significance. Genetic improvement is currently being centered on indigenous breeds because they have long adapted to extreme

harsh environmental conditions and might be more productive in their own environment than the exotic breeds (Alphonsus et al., 2010). Morphological characteristics provide useful information to detect genetic structure and individual breed's potentiality due to the intrinsic relationship among all biological characters (Zaitoun et al., 2005). The ratio of live weight to linear body measures may point to a new measure in judging body conformation traits especially in meat animals; however there exists paucity of information in the literatures towards this direction. The purpose of this study was to evaluate this ratio and consider if it is a basis for judging growth characteristics in goats.

## MATERIALS AND METHODS

### Study location

The study was carried out in Borno, Sokoto and Ogun States of Nigeria. These states were selected because these are some of the locations in Nigeria where stocks close to pure breeds of the goats are located.

### Animal selection

Three breeds of goats (Sahel goats from Borno State; Red Sokoto goats from Sokoto State; West African Dwarf goats from Ogun State) were selected for the present study. The goats were sampled in the abattoirs of the named states when brought in for slaughter either by the owners or by the slaughter men. It was observed that all the animals were brought into the abattoirs from villages and local markets. A total of nine hundred goats comprising of three hundred of each breeds, were selected. Each breed was grouped according to their age groups into three; <1, 1-2 and 2-3 years made up of fifty males and fifty females in each age group. These were evaluated for morphometric characteristics. The pairs of permanent incisors in the dentition of the goat were used to determine age (Adu and Ngere, 1979).

The following metric characteristics were measured on each animal: body weight (BW), age, horn length (HL), ear length (EL), shoulder width (SW), neck circumference (NC), body length (BL), withers height (WH), heart girth (HG), pouch girth (PG) and tail Length (TL). Weights of the animals were taken using a walk-in weighing scale with calibrations of 0.1 kg. Flexible tailor measuring tape was used to take the body measurement. During body measurement, animals were made to stand upright and restrained by two assistants in such a way that their heads, necks, and chest were stretched almost in a straight line. Each measurement was taken at least three times and the mean recorded to the nearest centimeter or kilogram. Reference marks used for body measurement according to the method of and Salako and Ngere (2002) are described as follows:

**Wither height (WH):** Vertical distance from ground to the point of withers measured vertically from the ridge between the shoulder bones to the fore hoof.

**Body length (BL):** Distance between points of shoulder to point of hip, that is, the distance from the first thoracic vertebrae to base of tail. This is also described as the distance between in the most cranial palpable spinosus process of thoracic vertebrae and either sciatic tubers or distance between the tops of the pelvic bone.

**Shoulder width (SW):** Measured as the horizontal distance between the two shoulders or distance between the lateral

tuberisities of the humeri which is also described as the widest point over the intraspinus muscle.

**Tail length (TL):** Measured from the base of the tail to the tip (Coccygeal vertebrae).

**Neck circumference (NC):** Taken as the circumference of the neck at the midpoint.

**Heart girth (HG):** Measured as the circumference of the body at the narrowest point just behind the shoulder perpendicular to the circumference of the body, just in front of the hind leg perpendicular to the body axis.

**Horn length (HL):** Measured as the average of the lengths of the two horns taken from the base to the tip. Average was used in order to make allowance for unexplained inequalities in horn length.

**Ear length (EL):** Measured as the distance from the base to the Zygomatic arch of the ear.

Obtained measures (X) were compared to body weight as X/BW and resulting ratio was subjected to analysis of variance using age and sex as classification variables with the Statistical Analysis System (2003) software.

## RESULTS

The ratios of linear body measurements to live weights in Red Sokoto, Sahel and WAD goats with respect to their age-groups were presented in Table 1. Results indicated that PG had the highest ratio of 4.32, 3.61 and 4.86 respectively for the three breeds of goat at <1 year of age. HL showed the least ratio (0.43 and 0.49) for Red Sokoto and WAD breeds while SC had the least ratio (0.50) for Sahel goats. At 1-2 years, PG had the highest ratio of 4.82, 3.68 and 3.58, respectively for the three breeds of goat. HL showed the least ratio of 0.50, 0.53 and 0.36 for Red Sokoto, Sahel and WAD goats. Above 2 years of age, PG also had the highest ratio of 3.32, 2.76 and 3.62, respectively for the three breeds of goat. HL showed the least ratio (0.39 and 0.37) for Red Sokoto and WAD breeds while SC had the least ratio (0.44) for Sahel goats.

The ratios of linear body measurements to live weights in Red Sokoto, Sahel and WAD does of age < 1 year indicate that highest ratios in WAD goat (4.93 for PG, 4.80 for HG and 4.59). HL showed the least ratio of 0.45, 0.53 and 0.50 for Red Sokoto, Sahel and WAD goats respectively. Between 1 - 2 years of age in does, PG had the highest ratio of 4.80, 3.39 and 4.64 for the three goat breeds. HL showed the least ratio of 0.41, 0.50 and 0.47, Red Sokoto, Sahel and WAD goats, respectively. Above 2 years, higher ratios were observed in PG for goats thus, 4.86 for Red Sokoto goats, 3.68 for Sahel goats and 4.04 for WAD goats and lowest ratios of 0.51, 0.55 and 0.40 for HL in the three goat breeds (Table 2).

Ratios of linear body measurements to live weights in Red Sokoto, Sahel and WAD bucks of age <1 year, 1 – 2 years and >2 years are presented in Table 3. Results indicate that PG had the highest ratio of 4.60, 3.68 and 3.17 and lowest for HL (0.50, 0.51 and 0.32) for the three breeds of goat. Similarly, at 1 – 2 years of age PG had the highest ratio in Red Sokoto (3.35), Sahel (2.84) and

**Table 1.** Ratios of linear body measurements to live weights in Red Sokoto, Sahel and WAD goats <1 year, 1 – 2 years and >2 years of age.

Age	Parameter	Red Sokoto	Sahel	WAD
<1 year	HL	0.43	0.51	0.49
	EL	0.75	0.79	0.90
	SW	1.02	1.29	1.22
	NC	1.73	1.59	2.27
	BL	3.15	2.62	3.98
	WH	3.90	3.10	4.56
	HG	4.17	3.46	4.74
	PG	4.32	3.61	4.86
	TL	0.89	0.83	0.98
	SC	0.67	0.50	0.83
1 – 2 years	HL	0.50	0.53	0.36
	EL	0.89	0.78	0.66
	SW	0.99	1.35	0.92
	NC	1.91	1.51	1.49
	BL	3.60	3.22	3.05
	WH	4.02	3.57	3.07
	HG	4.65	3.55	3.49
	PG	4.82	3.68	3.58
	TL	0.92	0.79	0.68
	SC	0.68	0.55	0.58
>2 years	HL	0.39	0.44	0.37
	EL	0.63	0.56	0.57
	SW	1.03	1.02	0.79
	NC	1.29	1.10	1.43
	BL	2.38	2.36	2.27
	WH	3.06	2.93	2.39
	HG	3.19	2.67	3.57
	PG	3.32	2.76	3.62
	TL	0.67	0.53	0.62
	SC	0.50	0.32	0.50

Horn length (HL); ear length (EL); shoulder width (SW); neck circumference (NC); body length (BL); wither height (WH); heart girth (HG); pouch girth (PG); tail length (TL); scrotal circumference (SC); and body weight (BW).

**Table 2.** Ratios of linear body measurements to live weights in Red Sokoto, Sahel and WAD does aged <1 years, 1 – 2 years and >2 years.

Age	Parameter	Red Sokoto	Sahel	WAD
<1 year	HL	0.45	0.53	0.50
	EL	0.74	0.85	0.92
	SW	0.97	1.34	1.22
	NC	1.65	1.55	2.25
	BL	3.05	2.61	4.03
	WH	3.79	3.13	4.59
	HG	3.88	3.68	4.80
	PG	4.03	3.85	4.93
	TL	0.87	0.86	0.99

**Table 2.** Continues.

1 – 2 years	HL	0.41	0.50	0.47
	EL	0.77	0.74	0.89
	SW	1.08	1.24	1.22
	NC	1.82	1.56	2.30
	BL	3.26	2.65	3.94
	WH	4.01	3.07	4.53
	HG	4.47	3.26	4.68
	PG	4.64	3.39	4.80
	TL	0.91	0.80	0.97
>2 years	SC	1.38	0.96	1.65
	HL	0.51	0.55	0.40
	EL	0.90	0.81	0.73
	SW	0.98	1.36	0.91
	NC	1.90	1.48	1.60
	BL	3.74	3.26	3.36
	WH	4.08	3.57	3.38
	HG	4.70	3.54	3.94
	PG	4.86	3.68	4.04
TL	0.92	0.79	0.71	

**Table 3.** Ratios of linear body measurements to live weight in Red Sokoto, Sahel and WAD Bucks <1 year, 1 – 2 years and >2 years of age.

Age	Parameter	Red Sokoto	Sahel	WAD
<1 year	HL	0.50	0.51	0.32
	EL	0.88	0.76	0.59
	SW	1.00	1.34	0.92
	NC	1.94	1.54	1.40
	BL	3.47	3.19	2.79
	WH	3.97	3.57	2.80
	HG	4.60	3.55	3.10
	PG	4.77	3.68	3.17
	TL	0.95	0.80	0.65
1 – 2 years	SC	1.37	1.11	1.09
	HL	0.39	0.45	0.38
	EL	0.65	0.58	0.59
	SW	1.04	1.06	0.78
	NC	1.31	1.15	1.45
	BL	2.38	2.48	2.29
	WH	3.07	2.99	2.44
	HG	3.23	2.74	3.60
	PG	3.35	2.84	3.66
>2 years	TL	0.69	0.54	0.62
	HL	0.38	0.43	0.35
	EL	0.62	0.55	0.55
	SW	1.04	0.98	0.80
	NC	1.28	1.06	1.40
BL	2.39	2.24	2.26	

**Table 3.** Continues.

WH	3.05	2.37	2.35
HG	3.16	2.62	3.54
PG	3.29	2.68	3.59
TL	0.65	0.51	0.62
SC	1.00	0.62	0.99

WAD goats (3.66), and HL for the 3 breeds studied were least (0.39, 0.45 and 0.38). At age above 2 years, PG maintained a higher ratio (3.29, 2.68 and 3.59) and least (0.38, 0.43 and 0.35) in HL for the breeds studied.

## DISCUSSION

The high body ratio range of 0.32 to 4.96 observed from these findings agrees with the report of Salako and Ngere (2002) who observed higher value of 3.21 in different goat breeds. This suggests that the traits are under the same gene action (Pleitropy). Also, the values obtained from this study were higher than the low values reported by earlier researchers in the temperate countries (Searle et al., 1989b; Herrera et al., 1996; Hassan and Ciroma, 1992). Animals could be tall or long but weigh less than stockier animals. Relationship of linear conformation traits with body weight body, condition score and milk yield in FriesianXBunaji cows were positive indicating that taller, wider, deeper and fatter cows tended to be heavier (Alphonsus et al., 2010). The high ratio associated with PG indicates that its measure is a probable discriminator among breeds of goats. It follows that higher ratio indicates higher contribution of a given morphometric part to live weight relative to that of other parts, so that selection could be made on the basis of this ratio. The linear increase in ratios within the first two age classification and subsequent decline at age >2 yrs across the breeds supports the sigmoid growth curve theory and indicates that that age has strong influence. The scenario is however not surprising since the size and shape of the animal is expected to increase as the animal is growing with age. There was wide variability as the age of the animals increased most particularly in the bodyweight. This was in consonance with the report of Orheruata and Olutogun (1984) in cattle.

## CONCLUSION

As observed in this study, PG consistently indicated high ratio and should be recommended for further studies as a selection factor in breeding and production of goats.

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**Citation:** Shoyombo J, Akpa GN, Yakubu H, Izebere J, Olawoye SO, 2015. Age and sex dimorphism of the ratio between body measurements to live weights in Red Sokoto, Sahel and West African Dwarf goats. *Net J Agric Sci*, 3(3): 81-85.

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