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Comparative Radiographic Mapping of the Skeletal System of Male and Female Savannah Monitor Lizard (*Veranus Exanthematicus*).

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ABSTRACT

The aim of this study is to establish the radiographic mapping of the skeletal system of the male and female Savannah Monitor lizards since there is a dearth of information on them. Radiographs of various parts of the skeletal system of a male and female monitor lizards were taken and their measured anatomic parts were compared. The Lizards were hand-captured and anesthetized with atropine sulfate (0.02 mg/kg), chlorpromazine (10mg/kg), and ketamine (15 mg/kg) for restaint and positioning for x-ray exposures. Using a portable X-ray machine, radiographs were obtained with the following exposure settings: for the body, KVP = 75, MA = 50, and mAs = 10; for the tail, KVP = 70, MA = 50, and mAs = 10. With the lizards on sternal recumbency, the radiographs of head to caudal abdomen including the limbs and tail were obtained. The number of vertebral bones, snout-to-tail length, vertebral length, horizontal and vertical rib lengths, and appendage lengths were obtained and images analyzed. The male lizard weighed 1.4 kg with a body length of 102 cm, while the female weighed 1.7 kg and had a body length of 105 cm. Comparison of the skeletal measurements revealed that both lizards had similar dimensions in terms of snout-to-tail length and the number of cervical, thoracic, and lumbar vertebrae. However, the female had more coccygeal vertebrae (45) compared to the male (43). Additionally, the female had longer horizontal ribs (6 cm vs. 4 cm) and vertical ribs (3 cm vs. 2 cm) compared to the male. In conclusion, the female monitor lizard exhibited greater body length, body weight, and rib dimensions, likely due to being older than the male as there is very little difference in rate of growth of both sexes when young.

Key words: Radiographic mapping, Skeletal system and monitor lizard

INTRODUCTION

Savannah Monitor Lizard (*Varanus exanthematic*), are Native to Africa, savannah monitors are adapted to dry and hot environments. They are so adapted that even their feeding habits changes depending on the season. During the wet season, the savannah monitor can consume almost one tenth of its body weight. When the weather becomes dry, they will begin to fast. They live off of the fat reserves from the wet season. The savannah monitor prefers to eat the poisonous millipedes as a tasty snack. It will rub its chin over the millipede in order for the millipede to emit its fluid and rub off the poison (Bayless and Luiselli, 2000).

They are stoutly built, with relatively short limbs and toes, and skulls and dentition adapted to feed on hard-shelled prey. They are robust creatures, with powerful limbs for digging, powerful jaws and blunt, peg-like teeth. Maximum size is rarely more than 100 cm. The skin coloration pattern varies according to the local habitat substrate. The body scales are large, usually less than 100 scales around middle part of their body, a partly laterally compressed tail with a double dorsal ridge and nostrils equidistant from the eyes and the tip of the snout (Cieri, 2018).

The mean asymptotic body weight of males was nearly three times higher than that of females at maturity. As the body size of male and female hatchlings is almost equal, and the growth rate parameter (K) of the logistic growth equation as well as the absolute growth rate up to the age of 12 months do not differ between the sexes, size differences between fully grown males and females should be attributed to timing of the postnatal growth. Males continue to grow several months after they reach the age when the growth of females is already reduced. Therefore, the sexual size dimorphism emerges and sharply increases at this period (Frynta *et al*, 2010).

Every tetrapod has a trunk made up of vertebrae, ribs, and multiple, overlapping muscle layers. The arrangement of these bones and muscles, however, differs greatly between species, allowing for highly derived body forms such as snakes and frogs (Koob & Long, 2000; Kardong, 2006; Young & Kardong, 2010; Bonnan, 2016). Because these bones and muscles serve as the vertebrate chassis, diversity in this anatomy represents multiple solutions to the biomechanical problems of locomotion (Gans et al. 1978; Carrier, 1996; Reilly & Delancey, 1997; Hoff & Wassersug, 2000; O'Reilly et al. 2000; Schilling, 2011), support (Janis & Keller, 2001; Daeschler et al. 2006), and ventilation (Carrier, 1996; Brainerd, 1999). Analysis of this diversity is therefore a useful lens to reveal the differing biomechanical and evolutionary pressures that led to the diverse vertebrate body shapes we observe today (Carrier, 1987; Burke et al. 1995; Koob & Long, 2000; Wiens & Slingluff, 2001; Ward & Brainerd, 2007). Although cataloguing this diversity is a logical first step, axial musculature remains relatively undescribed in many groups of terrestrial vertebrates. This study was carried out to provide baseline data on the radiographic features of the skeletal structures of the Savannah Monitor Lizard.

MATERIALS AND METHODS

Equipment and materials

X-ray Machine, X-ray Cassette, X-ray film (10” x 12” Fuji Films®, FUJIFILM Manufacturing Corp, Japan), Radiograph folder, Radiograph hanger, Radiograph viewer, Generator, Electric plug, Extension box.

Consumables: Disposable gloves and Tissue paper

Study animal: two Savannah monitor lizard were acquired from breeders in Samaru area

Experimental Procedure

The subjects used for this study were scanned as soon as they are acquired. The demographic data (Sex, Body weight and body length) was obtained.

Anesthetic Protocol

Prior to imaging, the Monitor Lizard was anaesthetized intramuscularly. Preanesthetics we used Atropine Sulphate (Atrone® , Asian Pharma India) 0.02 mg/kg , Chlorpromazine (Hanbet® , Jiangsu Ruinian Qianjin Pharmaceutical Co.Ltd, China) 2.5mg/kg and ketamine Hydrochloride (Swiss®,Swiss Parenterals, Gujarat India)(15mg/kg) used for induction and maintenance.

Exposure 0f the monitor lizard to X-ray radiation

The lizard was exposed at the following exposure factors for the body and tail respectively:

Body exposure factor.

- kVP = 75
- MA = 50
- mAs = 10

Tail exposure factor.

- kVP = 70
- MA = 50

mAs = 10

Plate I: Exposure of the tail region

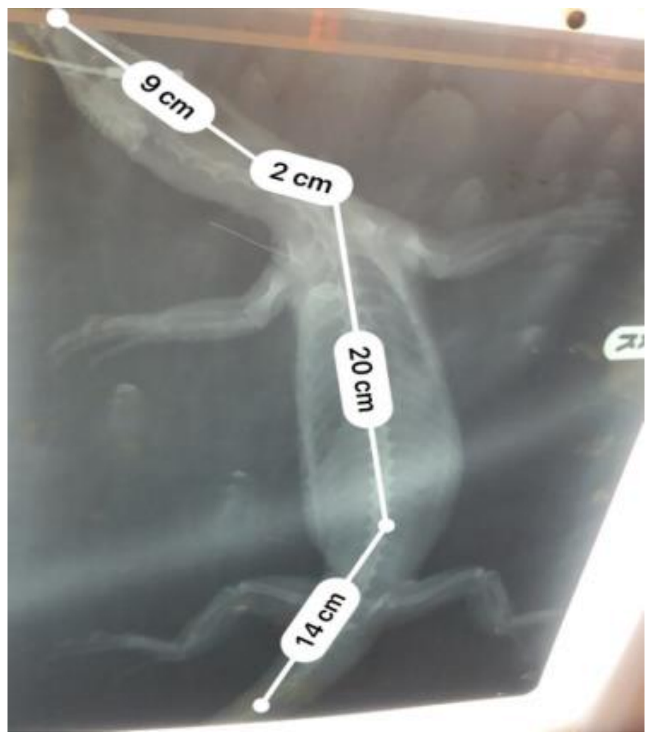

Plate II: Measurement from the snot to tail

Plate III: Measurement from the left forelimb

Plate IV: Measurement from the left forelimb

RESULTS

The male monitor lizard body weight was 1.4kg, length 102cm, snort length 5cm, cervical vertebral length 4cm, cervical vertebral number 5, thoracic vertebral length 4cm thoracic vertebral number 6, lumber vertebral length 15cm, lumber vertebral number 17, coccygeal vertebral length 55cm, coccygeal vertebral number 43, right humeral length 3cm, right radial length 3cm, right digital length 4cm, left humeral length 3cm, left radial length 3cm, left digital length 4cm, right femoral length 4cm, right tibia length 3cm, right digital length 4cm, left femoral length 4cm, left tibia length 4cm, left digital length 5cm, Horizontal length of ribs 4cm, vertical length of ribs 2cm, space in between each rib 1cm

The female monitor lizard weighed 1.7kg, body length 105cm, snort length 5cm, cervical vertebral length 6cm, cervical vertebral number 5, thoracic vertebral length 4cm thoracic vertebral number 6, lumber vertebral length 15cm, lumber vertebral number 17, coccygeal vertebral length 58cm, coccygeal vertebral number 45, right humeral length 3cm, right radial length 4cm, right digital length 4cm, left humeral length 3cm, left radial length 3cm, left digital length 4cm, right femoral length 5cm, right tibia length 3cm, right digital length 4cm, left femoral length 4cm, left tibia length 4cm, left digital length 5cm, Horizontal length of ribs 6cm, vertical length of ribs 3cm, space in between each rib 1cm

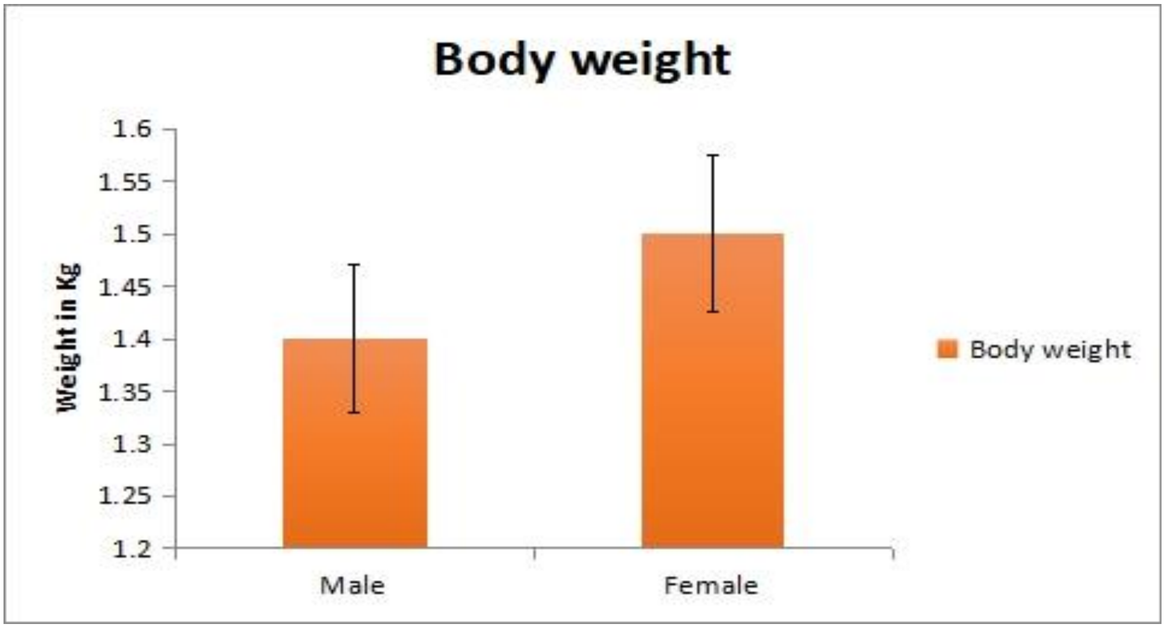

Figure I: Bar Chat showing body weight of both the male and female

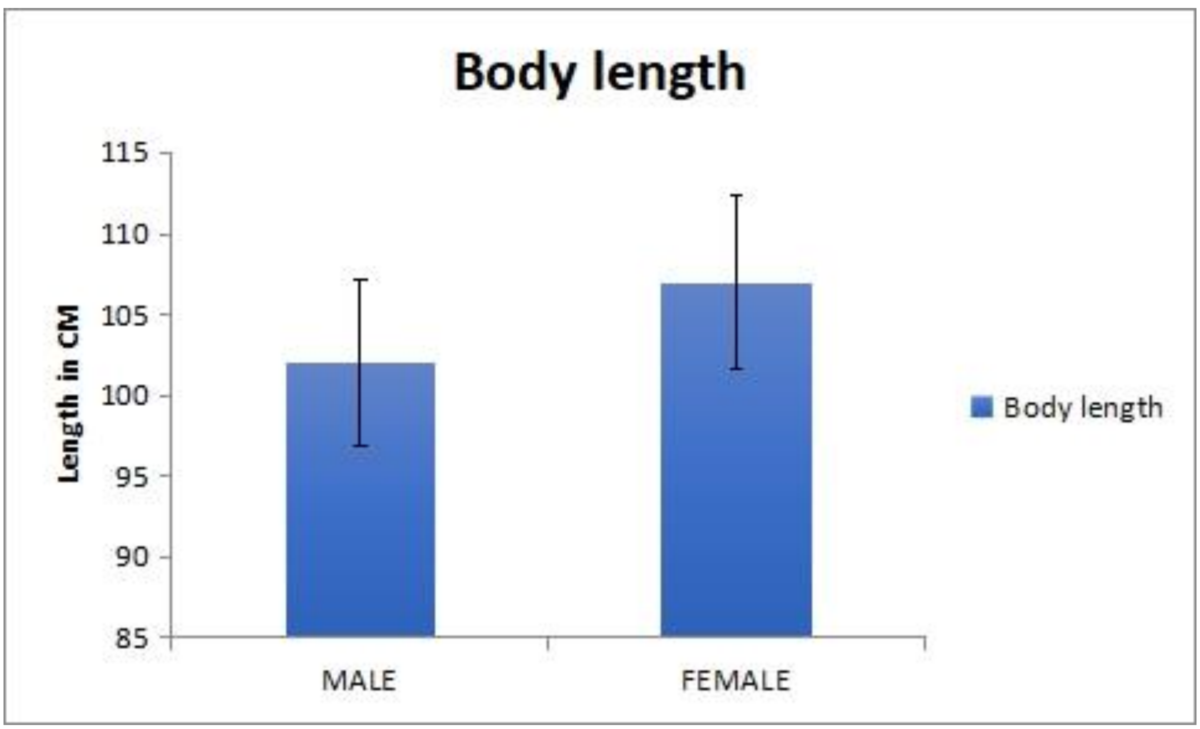

Figure II: Bar Chat showing body length of both the male and female

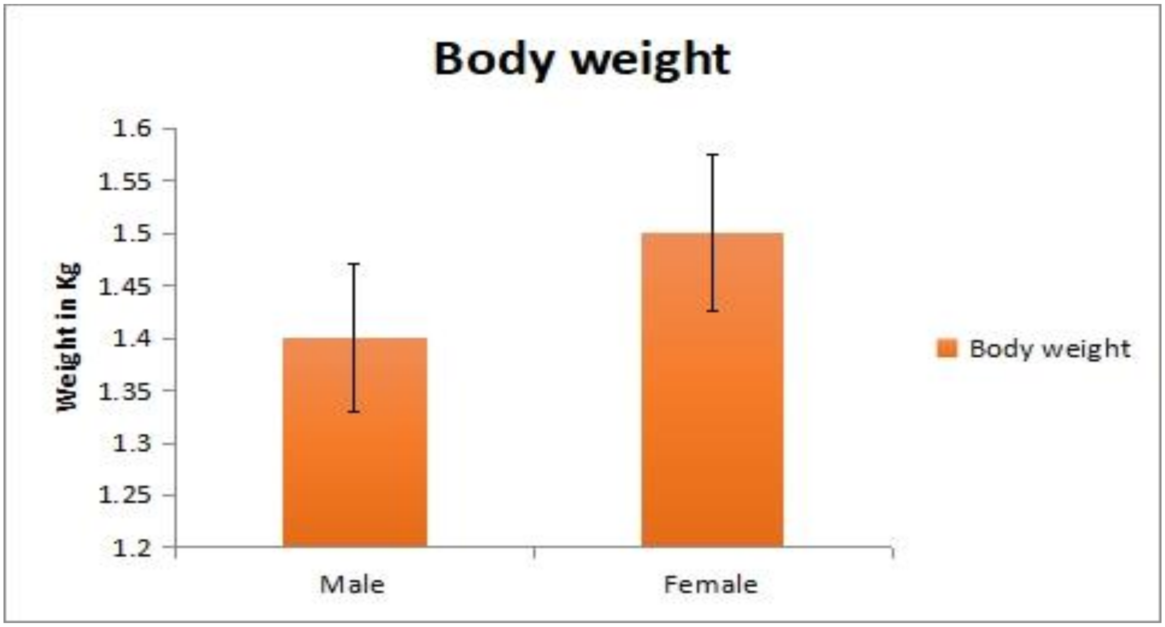

Figure I: Bar Chat showing body weight of both the male and female

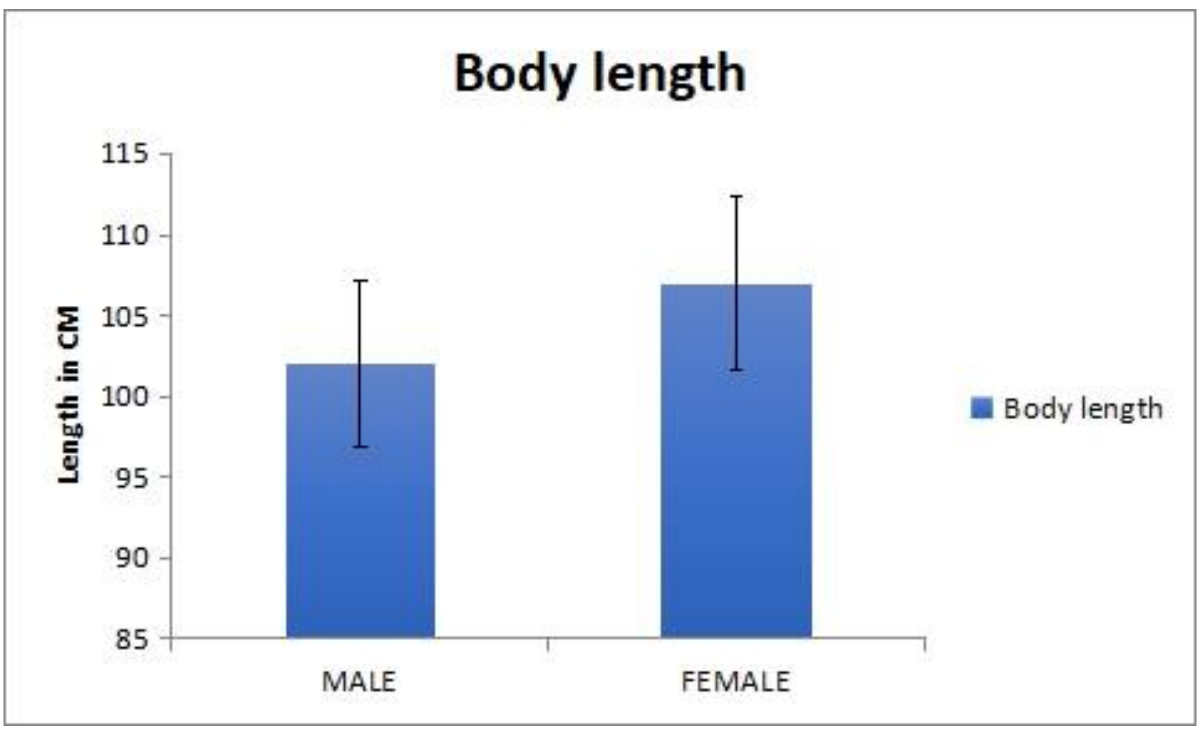

Figure II: Bar Chat showing body length of both the male and female

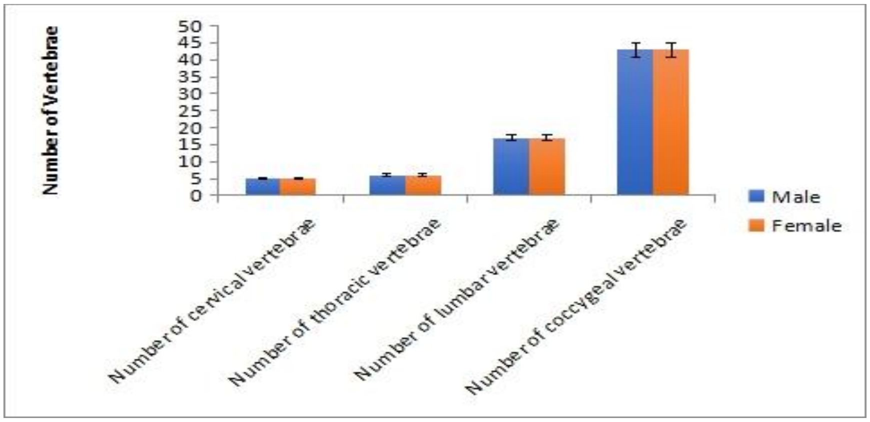

Figure III: Bar Chat showing number of Vertebrae of both the male and female

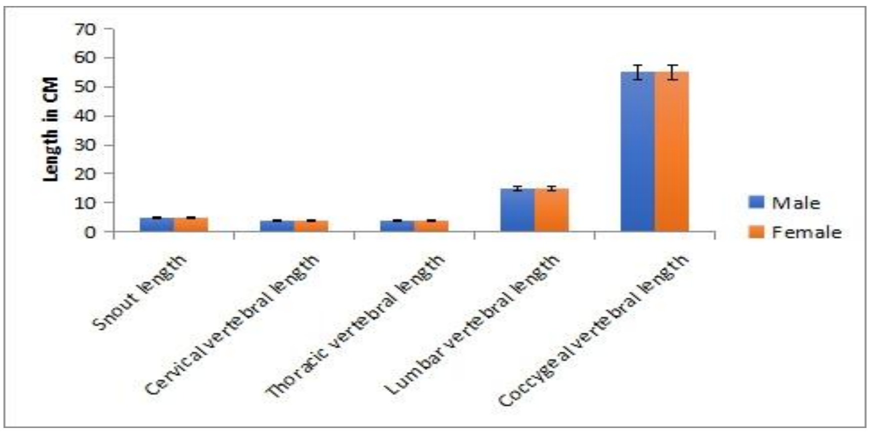

Figure IV: Bar Chat showing Length of Vertebrae of both the male and female

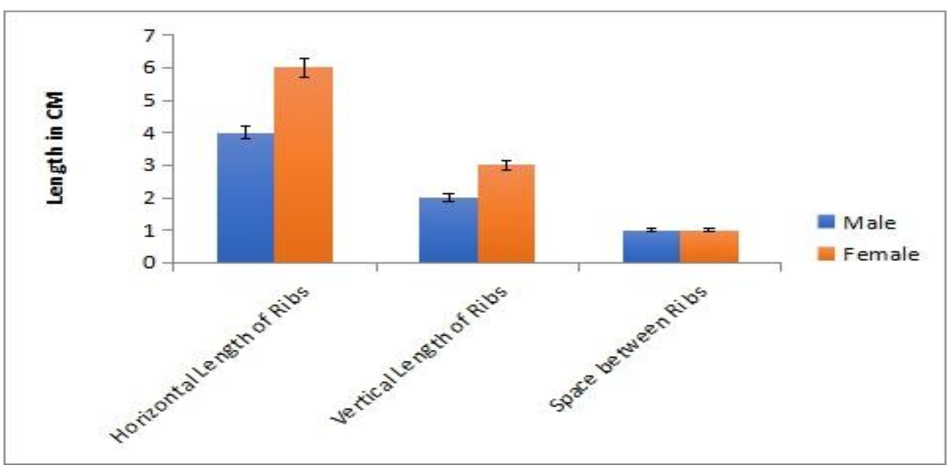

Figure V: Bar Chat showing distribution ribs of both the male and female

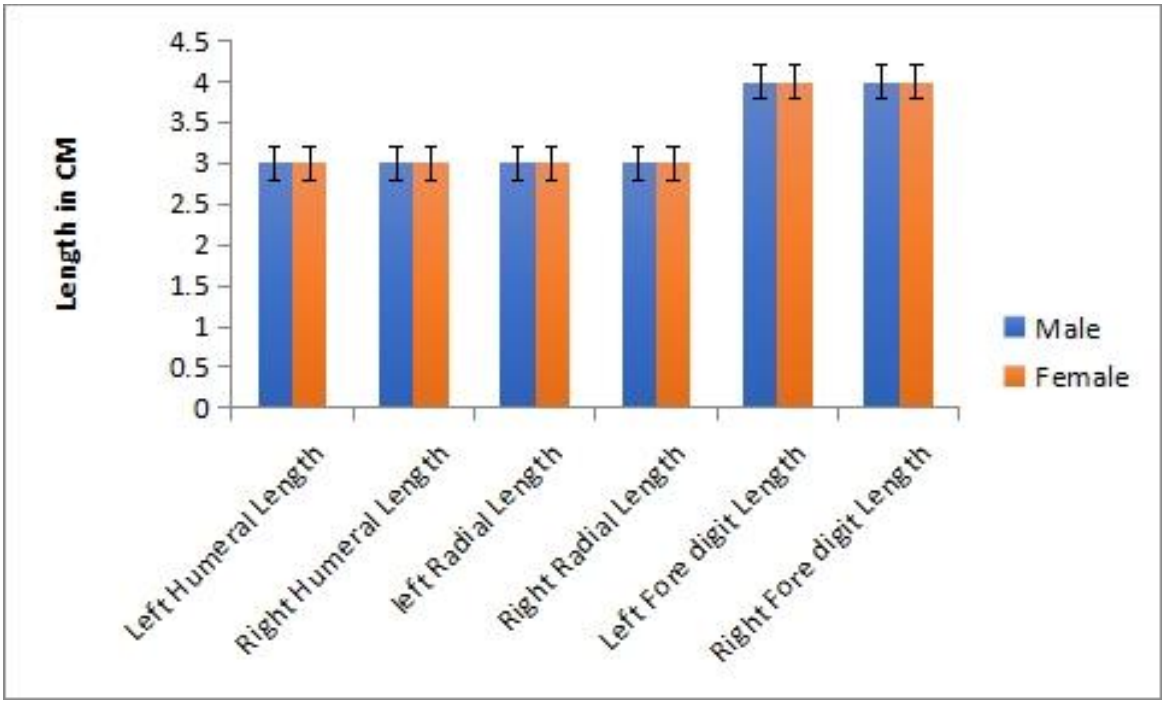

Figure VI: Bar Chat showing length of the forelimbs of both the male and female

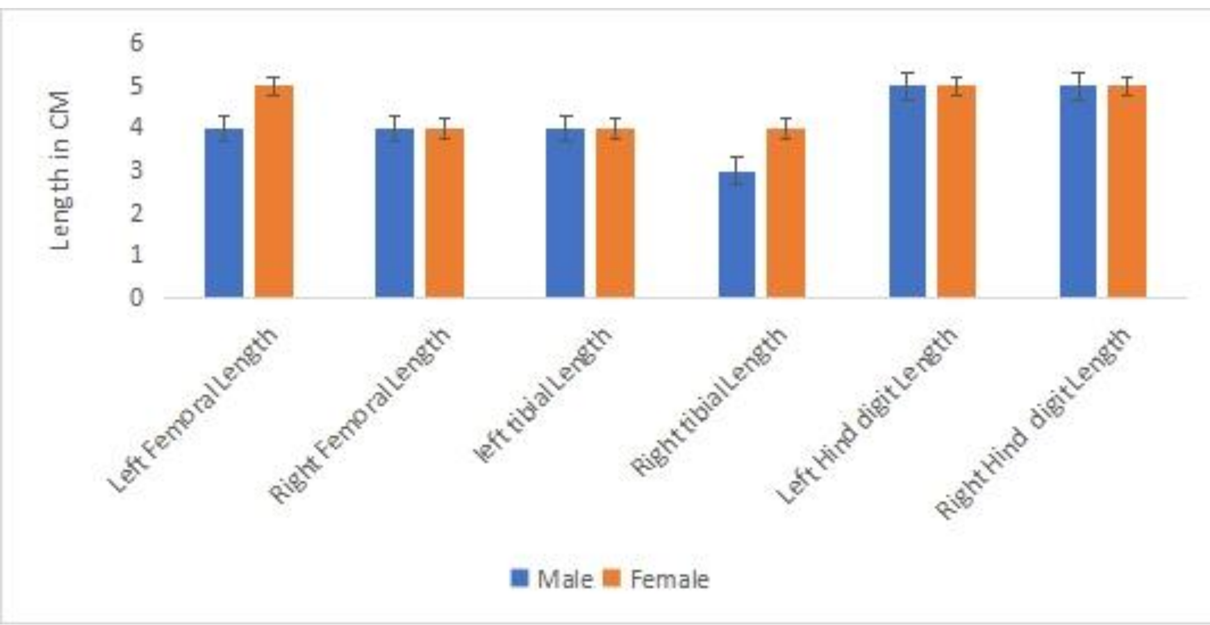

Figure VII: Bar Chat showing length of the hind limbs of both the male and female

DISCUSSION

The snot length of both lizards was relatively the same at the time of study, discovering that the male was younger and as they both grow older the male has the tendency of having a broader looking head when compared to contemporary female, which serve as criteria to distinguish between male and female monitor lizard.

There are 28 presacral vertebrae in *V. exanthematicus* and the sixth vertebra is the first to bear ribs. The number of presacral vertebrae ranges between 27 and 35 among observed varanids (Cieri 2018). on the radiograph the number of the presacral vertebrae the savannah monitor lizard amounted to 28 presacral vertebrae. In *V. exanthematicus*, the first four ribs are cervical ribs, consisting of a single bony portion. The first two ribs are significantly smaller than the third and fourth, Caudally, three bipartite true ribs consist of a bony vertebral portion and a sternal portion made of calcified cartilage that articulates with the sternum. A flexible intercostal joint joins the vertebral and sternal portions, but the sternal portions are also flexible at its most laterally extending point, such that there are functionally two intercostal joints among the true ribs (Cieri 2018). From this study, Horizontal length of the ribs was 4cm, vertical length of the ribs was 2cm, inter - costal space in between each rib was 1cm.

The Average length of Savannah Monitor lizards measure between 3 to 4 feet (91.4 – 122cm), with some exceptional individuals reaching up to 5 feet. As for their weight, adult monitors can tip the scales anywhere from 8 – 13 pounds (3.6 – 5.4 kilograms) (tarikregad, 2023). The mean length of 104.5 ± 2.5 and the mean weight of 1.45 ± 0.05

The Appendages of both monitor lizard where relatively of equal length with the exception of the length femoral length and right tibial length of the female monitor lizard was a centimeter above that of the male, we attributed to either physical error or from the positioning of the female.

CONCLUSION AND RECOMMENDATION

The female monitor Lizard used for the study revealed that the body length, body weight, horizontal and vertical length of the ribs were relatively above that of the male monitor lizard which may be attributed to her being older than the male.

Additional studies should be conducted using same age in order to have a more convincing data on the Radiographic anatomical mapping of the skeletal system of the monitor lizard.

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