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Some aspects of the craniofacial indices and macro neurometrics of the Nigerian local pig (*Sus scrofa*)

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Summary

This study is about the craniofacial indices and neuromorphometrics of the Nigerian local pig and has been performed on twelve males and fourteen females of ages one and a half to two years. The average values obtained for the tongue length, tongue weight, rasp length, left pinna length, right pinna length, left pinna width, right pinna width, height of left external nares, height of right external nares and the rima oris length were 17±1.3 cm, 90±16 g, 4.6±0.58 cm, 13±1.3 cm, 13±1.3 cm, 8.7±1.5 cm, 8.7±1.4 cm, 0.98±0.12 cm, 0.96±0.13 cm and 19.51±2.89 cm respectively, while the mean brain weight, mean brain length, cerebrum and cerebellum lengths, brain and cerebellar heights were 84±12 g, 6.9±1.5 cm, 4.9±1.7 cm, 2.2±1.0 cm, 5.2±0.88 cm and 3.0±1.1 cm respectively. There was a negative correlation between the weight of the animal and the height of the cerebellum, the length of cerebrum and length of the cerebellum and between the weight of the head and height of the cerebellum. A positive correlation was however observed between the length of brain and the weight of brain, and between the length of the cerebrum and weight of brain. The cerebral length was statistically longer ($P < 0.01$) in the males than the females. The data obtained from this study will provide added information in the field of comparative anatomy and porcine neuroanatomy research.

Key words

Nigerian local pig, brain, craniofacial indices, morphology.

Introduction

The pig, *Sus scrofa*, belongs to the super-order *Ungulata* with the other hoofed mammals. The four digits place it in the order of even-toed hoofed animals, namely the Artiodactyla (Dyce et al., 2002). In Nigeria, the estimated total pig population is about 3.5million (Bourn et al., 1994). Few animals have such economic importance to mankind yet suffer from such a deplorable image as does the pig. As a domestic animal it is a source of a wide variety of meat, high quality leather, durable bristles for many kinds of brushes, and hundreds of medical products. At the same time, the pig is frequently regarded as unclean and even untouchable by many people (Guiffra et al., 2000).

In spite of their reputation, pigs are neither filthy nor stupid; because their sweat glands are relatively ineffective in lowering body temperature, pigs seek relief from the heat by wallowing in mud or shallow water holes, however, when provided

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with a clean environment sheltered from the sun, pigs tend to prefer a clean environment. Furthermore, in tests of intelligence, pigs have proven to be quite smart (Guiffra et al., 2000).

Basic researches involving the pig include studies on the skull (Endo et al., 2002), reproductive system (Oyeyemi and Ubiogoro, 2005) and genomic study (Wernersson et al., 2005). There remains a dearth in the literature on the anatomy of the craniofacial region of the Nigerian local pig. This work aims to report investigations on craniofacial morphometry and neurometrics of the Nigerian local pig to serve as baseline data to find application in comparative anatomical, physiological, and gender variation studies.

Materials and methods

A total of twenty six, clinically healthy pigs, aged one and a half to two years, comprising twelve males and fourteen females, were used for this study. They were obtained at the Oyo State abattoir, Bodija, Ibadan, Nigeria where the animals were restrained and killed by quick decapitation at the atlanto-occipital joint. The heads were put in ice packs and transported to the laboratory. Measurements were taken with the aid of a weighing scale, digital vernier caliper and a Microwa® Swiss balance (Mettler-Toledo, Greifensee, Switzerland).

The brains were removed according to the method of Olopade and Onwuka (2002) and Olopade et al., (2005) and were weighed immediately after removal. Linear measurements on the brain were taken based on landmarks shown in Figs 1 and 2. All the craniofacial and neurometric parameters measured in the study are herein described:

1. **Weight of animal (WOA**): this was determined using a standard abattoir weighing scale.
2. **Weight of head (WOH)**: this was measured after slaughter and head severed at the occipitoatlantal joint using a weighing scale.
3. **Length of palpebral fissure (left and right- PFLL and PFLR respectively)**: distance between the medial and lateral canthi of each eye. This was measured by a digital vernier calliper.
4. **Length of the rima oris (ROL)**: distance between the two commissures of the oral cavity. This was measured by a twine, and the length determined by a vernier calliper.
5. **Pinna length (left and right- PiLL and PiLR respectively)**: longitudunal distance from the middle of the base of the pinna to its tip. It was measured by a vernier caliper.
6. **Pinna width (left and right)**: the greatest distance measured across the pinna. It was checked checked with a piece of twine and in turn measured by a vernier caliper.
7. **Height of external nares (left and right)**: the greatest distance between the dorsal and ventral borders of the external nares. It was measured by a vernier caliper.
8. **Length of tongue (TL)**: distance from the root of the tongue, at the point of attachment to the epiglottis and the hyoid apparatus to the tip. The tongue was placed on a table and the length determined by digital vernier caliper.

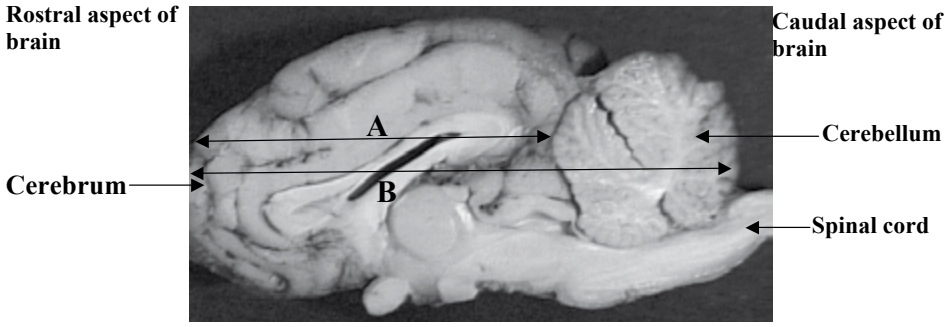

Figure 1 – Schematic diagram of porcine brain showing landmarks used for neurometrics. A = Length of cerebrum. B = Length of brain.

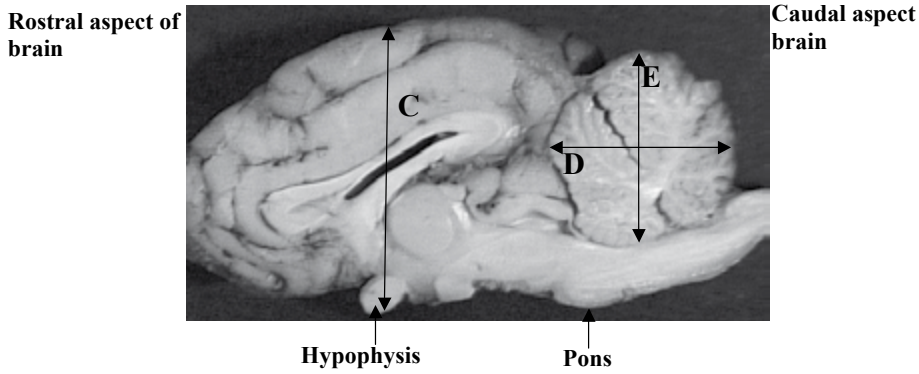

Figure 2 – Schematic diagram of porcine brain showing landmarks used for neurometrics. C = Depth of brain. D =Length of cerebellum. E = Height of cerebellum.

9. **Weight of tongue (TW)**: the tongue was severed at its root and from underlying muscles and then weighed using a weighing balance.
10. **Torus linguae length (TRL)**: length of the ridge at the dorsal elevation of the tongue (*torus linguae*).
11. **Weight of brain (WOB)**: relatively cold pig heads were cut midsagittally and brains removed and then allowed to thaw. The brain was then weighed using a weighing balance.
12. **Length of brain (LOB)**: distance from the most rostral point of the olfactory bulb to the medulla oblongata (Fig. 1).
13. **Depth of brain (DOB)**: distance from the dorsal aspect of the cerebrum to the ventral aspect of the brainstem (Fig. 2).
14. **Length of cerebrum (LOC)**: distance from the rostral pole of the cerebrum to the caudal pole, caudal to the occipital gyrus (Fig. 1).
15. **Height of cerebellum (HOCB)**: distance from the highest point of the median vermis to the roof of the fourth ventricle (Fig. 2).

16. **Length of cerebellum (LOCB)**: distance from the most rostral end of the cerebellum where it is in contact with the cerebrum, to the most caudal point or far extremity, rostral to the medulla oblongata (Fig. 2).

Statistical analysis. All data were presented as mean ± standard deviation. Statistical analysis was done using Student's t-test and correlation analysis with the Graphpad prism V4 software. Statistical significance was reported at $P < 0.05$ and $P < 0.01$.

Results

The data obtained for craniofacial and neurometric indices in this study are shown in Tabs 1 and 2.

The values obtained for the tongue length, tongue weight, rasp length, left and right pinna lengths in the males were very similar to those obtained in the females, while the values obtained for the left and right pinna widths, height of the right external nares and the rima oris length in the males were higher than in the females. On the contrary, the height of left external nares in the females was slightly higher than in the males; no statistically significant differences were however observed for any craniofacial value between genders ($P < 0.05$).

The mean brain weight was found to be 84±12 g while the mean weight of the head was 2.0±0.52 kg. The female pigs had a significantly lower ($P < 0.01$) length of cerebrum when compared with the males. There was a positive correlation between the weight of the animal and the weight of the head ($P < 0.01$), and between the weight of head and weight of brain ($P < 0.05$) while there was a negative correlation between the weight of the animal and the height of the cerebellum ($P < 0.05$), and between the weight of the head and height of the cerebellum ($P < 0.05$).

A positive correlation was observed between the length of brain and the weight of brain ($P < 0.01$), and between the length of the cerebrum and weight of brain ($P < 0.01$), while negative correlation existed between the length of cerebrum and length of the cerebellum ($P < 0.01$).

Discussion

The values obtained in both genders for the craniofacial indices were very similar; however, the males had higher values for the pinna width, height of the external nares and the rima oris length. While it is speculative that greater width of the pinna and external nares in the male be due to their protective role by enabling them hear and smell better the presence of predators or danger, the wider rima oris may indicate a morphophysiological adaptation to the character of the males as more voracious eaters. The slight asymmetry observed between the left and right pinna widths and external nares is similar to the reports of Olopade et al. (2005) in Nigerian goats and Balcioglu et al. (2009) in human osteometric studies.

The relative head weight, rima oris length and the right and left external nares length, obtained in this study were higher than their equivalents in the West African Dwarf goats (Olopade and Onwuka, 2004). The relative head weight and tongue

Table 1 – craniofacial and neurometric indices of the Nigerian local pig (*Sus scrofa*).

Parameters N=26	WOA (kg)	WOH (kg)	TL (cm)	TW (g)	TRL (cm)	PiLL (cm)	PiLR (cm)	PiWL (cm)	PiWR (cm)
Mean±SD	19±1.3	2.0±0.52	17±1.3	90±16	4.6±0.58	13±1.3	13±1.3	8.7±1.5	8.7±1.4

Parameters N=26	ENL (cm)	ENR (cm)	ROL (cm)	WOB (g)	LOB (cm)	DOB (cm)	LOC (cm)	DOCB (cm)	LOCB (cm)
Mean±SD	0.98±0.12	0.96±0.13	19.51±2.89	84±12	6.9±1.5	5.2±0.88	4.9±1.7	3.0±1.1	2.2±1.0

Table 2 – craniofacial and neurometric indices of the Nigerian local pig (*Sus scrofa*) based on gender.

Parameters N=26	WOA (kg)	WOH (kg)	TL (cm)	TW (g)	TRL (cm)	PiLL (cm)	PiLR (cm)	PiWL (cm)	PiWR (cm)
Males N= 12	19±1.4	2±0.56	17±1.1	90±18	4.7±0.59	13±1.5	13±1.5	9.1±1.9	8.9±1.5
Females N=14	19±1.3	2±0.51	17±1.5	90±15	4.6±0.59	13±1.1	13±1.1	8.5±1.1	8.6±1.2

Parameters N=26	ENL (cm)	ENR (cm)	ROL (cm)	WOB (g)	LOB (cm)	DOB (cm)	LOC (cm)	DOCB (cm)	LOCB (cm)
Males N= 12	0.96±0.17	0.97±0.14	20.2±3.29	85±12	7±1.8	5±0.37	5.6±0.72*	2.6±0.36	2±0.79
Females N=14	1±0.02	0.95±0.14	18.9±2.43	83±12	6.8±1.4	5.5±1.2	4.1±2.1*	3.4±1.4	2.5±1.2

Data presented as mean ± standard deviation.

* Shows significant difference (at $P < 0.01$) between the male and female values.

Key: WOA: weight of animal; WOH: weight of head; TL: tongue length; TW: tongue weight; TRL: torus linguae length; PiLL and PiLR: pinna length, left and right respectively; PiWL and PiWR: pinna width, left and right respectively; ENL and ENR: height of external nares, left and right respectively; ROL: length of rima oris; WOB: weight of brain; LOB: length of brain; DOB: depth /height of brain; LOC: length of cerebrum; LOCB: length of cerebellum; DOCB: depth/height of cerebellum.

weight (1:10 and 1:22 respectively) in both genders were the same, showing that these values were fairly constant between genders. The lack of gender disparity observed in the tongue parameters is consistent with the report of Stiebert (1985) in human foetuses and children. It is striking however that though the weights were similar the males, which had a longer rima oris, also had a longer torus liguae length; the latter is studded with conified papillae and aids prehension. The value we obtained for tongue length is similar to that recently obtained in the Sambar deer (Sreeranjini et al. 2010). Our data show the quantitative relationship between the tongue and craniofacial indices in the Nigerian local pig.

The values obtained for the brain weight, brain length and the length of the cerebrum were higher in the males; however, the females had higher values for the heights of the brain and cerebellum and the length of the cerebellum. Animal experiments have found structural changes in the cerebellum in response to long-term motor skill activity (Hutchinson et al., 2003); Olopade et al. (2007) reported that the early and sustained dominance of the cerebellar length in the Sahel compared to other goat breeds in Nigeria could be a developmental adaptation of skillful movements due to possession of long legs in this breed. The relatively higher cerebellum neurometrics in the female may thus imply a response to a specialised motor activity relative to the males. The longer cerebral length observed in the males may likely impact a gender based difference in the neurocranial lengths.

The brain weight obtained in this study (84±12 g) was smaller than the 94.5 g and 100 g reported on Large White pigs by Felix et al. (1997) and feral pigs (Kruska and Rohrs, 1974). The mean weight of the pigs used by those authors however were 58 kg and 53 kg compared to 19 kg in our study. The equivalents of brain weight obtained in the Nigerian goats are as follows: Sahel (85.13±1.97 g), Red Sokoto goat (85.85 g), and 56.89 g in the West African Dwarf goat (Olopade et al., 2007). The relative brain weight of 1:250 is lower than that of cats and dogs (1:100 and 1:125 respectively), higher than that of the lion, elephant and horse (1:550, 1:560, 1:600 respectively) (Kuhlenbeck, 1973) but very similar to the value obtained in the Sahel goat (1:250) (Olopade et al., 2007). The slightly heavier brain obtained in the males is consistent with that obtained in the Nigerian Sahel goat (Olopade et al., 2007).

In conclusion, the results obtained in this study will form a baseline possibly useful in the area of comparative, craniofacial and neuro-anatomy of the pig.

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