

## CRANIAL CAPACITY OF SHEEP AND GOAT (With 4 Tables and One Figure)

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السعة الخفية في الخروف والماعز

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استخدمت في هذه الدراسة جماجم ثلاثون حيوانا ، خمسة عشرة منها للخراف ، والخمسة عشرة الأخرى للماعز - أنواع ألمانية مستأنسة - ولقد وجد أن السعة الخفية للأغنام حوالي ١٢٢.١٥ مليليترا بينما كانت في الماعز ٩٥.٨٥ مليليترا . ولتقدير السعة الخفية من قياسات الججمة الخارجية استخدمت معادلات الانحدار المتعددة - ست وايز - والتي أعطت أقرب تقدير لسعة المخ بالمقارنة بسعة المخ الحقيقية في كلا النوعين الخراف والماعز.

### SUMMARY

A total of 30 skulls were used in this study with the aim of determining their cranial capacity and inturn the normal brain size. Of these skulls 15 came from sheep and the rest from goat. The average cranial capacity of the sheep was 122.15 and the goat was 95.85 ml. For estimation of the cranial capacity formula from the external skull measurements in the sheep and goat, the Stepwise multiple regression equations which gave a closer estimate as compared to the actual cranial capacity values were computed.

### INTRODUCTION

The present study was carried out to determine the necessary data for cranial capacity in the german races of sheep and goat (*Ovis ammon* & *Capra hircus*). the other motivations of the study were to determine separately in the sheep and goat the significant relationship, if any, between any one (or more) external skull measurement(s) and the cranial capacity; and to determine the possibiliy of predicting, within reasonable limits, the cranial capacity from known external skull measurement(s). This will yield a ready estimate of the brain size in these species of animals.

### MATERIALS and METHODS

A total of 30 skulls were used in this study. Of these 15 skulls came from the german race of domestic sheep (*Ovis ammon*) and the other 15 from the domestic goat (*Capra hircus*). The age of the animals ranged between 1.5-4 years. After maceration the skulls were subjected to measurements as skull length, skull width, cranial length, cranial width, facial length, facial width, skull weight, orbital hight, orbital width, interorbital distance (rostral, middle and caudal), mandibular length and mandibular weight. The cranial capacity of each skull was determined and estimated in accord to the method advocated by RAO (1967) using rice seed instead of



mustard seed. For recording the orbital capacity, foramina opening into the orbital cavity were plugged with cotton. The communication between orbital cavity, temporal fossa was blocked with a cotton and the whole orbital cavity was lined with a very soft thin tissue. Then this cavity was filled with small rice seed to the level of orbital rim. The contents were emptied and measured in measuring cylinder. The cranial, facial and orbital indices were determined as follows :

$$\text{Cranial index} = \frac{\text{skull width} \times 100}{\text{skull length}}$$

$$\text{Facial index} = \frac{\text{facial width} \times 100}{\text{facial length}}$$

$$\text{Orbital index} = \frac{\text{orbital height} \times 100}{\text{orbital width}}$$

To determine the relationship, if any, between the cranial capacity and the other parameters, the simple correlation coefficients between these and the cranial capacity as well as between each other were computed (Table 2). The Stepwise multiple regression equations were also computed to facilitate the prediction of cranial capacity from other parameters, using the Statistical Package provided in the SPSS update 7-9 (Statistical Package for the Social Science), release 1.10.

### RESULTS and DISCUSSION

The data obtained for the sheep and goat have been shown separately in Tables (1,2). To determine the relationship between the cranial capacity and the external skull measurements such as skull length, skull width, cranial length, cranial width, facial length, facial width, skull weight, orbital capacity, orbital height, orbital width, interorbital distance (I.O.D.), rostral, middle and caudal, mandibular length and mandibular weight, representative cranial capacity values as well as simple correlation coefficients were computed separately for the sheep and goat (Table 3). The average cranial capacity and its standard error of the sheep and goat was  $(122.155 \pm 5.355)$  and  $(95.846 \pm 8.119)$  respectively. From table (3) it appears that in the goat the cranial length, interorbital distance (rostral), facial length and orbital height had highly significant positive correlation (1%) with the cranial capacity and had a significant positive correlation (5%) with the skull length, skull width, skull weight, orbital capacity, orbital width, interorbital distance (middle and caudal), mandibular length and mandibular weight. In the sheep, although the caudal interorbital distance, cranial length and skull weight have the largest correlation coefficient values, they are not statistically significant determining factors in relation to the cranial capacity.

The average cranial capacity of the sheep and goat in comparison to other animals is represented in Table (4). CAMORON (1928) mentioned highly favourable correlations between cranial capacity and breadth in the brachycephalic Mongol skulls. In the bovine skull ROA (1967) observed significant relationship (5% level) between the skull width and cranial capacity. In the camel this correlation was with cranial height, orbital width and orbital area (SANDHU and DHINGRA, 1986). In the goat skull the correlations (1%) were with cranial length, facial length, orbital height and the rostral interorbital distance.

In the sheep the multiple regression equation employing two variables, the caudal and middle interorbital distances, yields the estimate of cranial capacity in



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the majority of cases (65%). The equation for prediction of the cranial capacity is expressed as :

$$(Y = 46.28 + 20.25 C - 1681 M)$$

Y = cranial capacity

C = interorbital distance (caudal)

M = interorbital distance (middle)

The F value beying highly significant (/ 0.01).

In the goat the regression equation employing only one external skull measurement i.e. the cranial length, provides a measure for prediction of cranial capacity in 77.24% of the cases. The equation in the goat is expressed as :

$$(Y = 58.48 + 9.14 CL)$$

Y = cranial capacity

CL = cranial length

The F value beying highly significant (/ 0.01).

The external appearance of the skull specially that of cranial part, appeared to be closely related to its cranial capacity specially in the goat in which the cranial length shows a highly significant correlation. This may argued to the comparatively lesser thickness of the bony plates of the cranial vault. This observation is in agreement with SANDU and DHINGRA (1986) in the Indian camel and MALIK and SHANKER (1979) in the pig, while contradicted the findings of ROA (1967) in buffalo and ox. HAJNIS (1962) stated that the skull capacity in no way dependant on the form of the skull. This openion is accepted here on the sheep as their skull measurements are not significant determing factor in relation to the cranial capacity.

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## REFERENCES

- Camoron, J. (1928): Craniometric studies. XII Correlation between cranial capacity and cranial length, breadth as studied in the Alska Indian crania. Amer. J. Phys. Anthropol. 11: 290-299.
- Chaturvedi, R.P. and Harneja, N.K. (1962): Cranial capacity, facial angles and gnathic index in adult human skulls. J. Anat. Soc. India., 11: 18-23.
- Drennan, M.R. (1927): A contribution to the pilttdown problem. Nature, 120 (3033): 874.
- Hajnis, K. (1962): Evaluation of different methods of calculation of skull capacity for lineal measurements. Ceskolov. Merfol., 10: 220-233 -cited by G.S. RAO (1967).
- Malik, M.R. and Shankar, K. (1979): Relationship among skull parameters and prediction of endocranial Volume in pig. Indian Veterinary Medical Journal 3: 237-41.

- Miller, M.S.; Christensen, G.C. and Evans, H.E. (1964): The skeletal system, skull. In Anatomy of Dog. pp. 6-49. W.B. Saunders Co., Philadelphia.
- Rao, G.S. (1967): Cranial capacity of adult bovine skull. Journal of the Anatomical Society of India, 16: 121-27.
- SPSS/PC (1984): Statistical Package for the Social Science. Release 1.10. SPSS Inc. 444 North Michigan Avenue, Chicago, IL 60611.

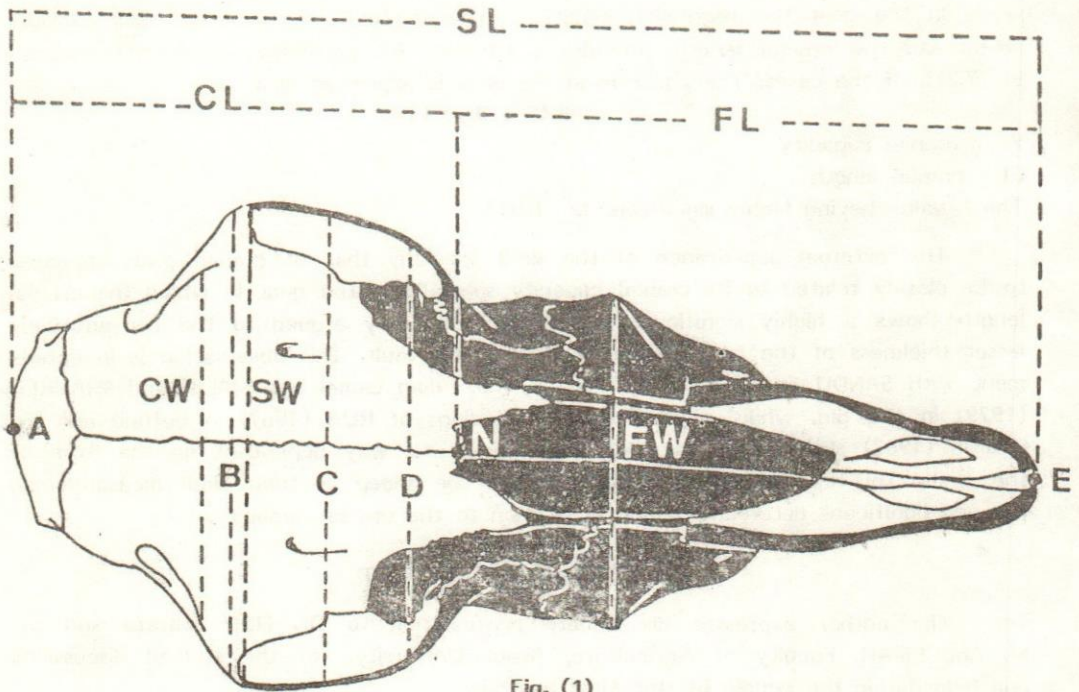


Fig. (1)

Dorsal view of the goat's skull indicating various measurements.

A: middle point of nuchal crest; N : nasion;  
 E: middle point of interincisive fissure;  
 SL: skull length; CL: cranial length; FL: facial length;  
 CW: cranial width; B: interorbital length (caudal);  
 SW: Skull width; C: interorbital length (middle);  
 D: interorbital length (rostral);  
 FW: facial width.



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Table 1 Data collected for sheep and goat

	S h e e p			G o a t		
	Range	Mean	S. O.	Range	Mean	S. O.
1. Skull length (cm)	28.0- 37.0	33.215	3.024	19.5- 38.0	27.715	5.353
2. Skull width (cm)	11.2- 16.6	13.546	1.522	9.0- 17.5	12.192	2.321
3. Cranial length (cm)	16.3- 21.8	18.308	1.703	13.0- 21.5	16.931	2.816
4. Cranial width (cm)	7.0- 9.0	7.769	.571	6.7- 9.7	7.831	0.920
5. Facial length (cm)	11.5- 17.0	14.892	1.747	6.5- 16.0	11.646	2.771
6. Facial width (cm)	8.0- 11.4	9.254	1.040	6.5- 11.3	8.415	1.519
7. Skull weight (gm)	110.0-600.0	333.462	128.572	75.0-650.0	291.923	174.255
8. Orbital capacity (ml)	35.0- 56.0	45.615	8.827	11.0- 58.0	31.692	13.066
9. Orbital height (cm)	3.5- 4.3	4.008	0.243	2.7- 4.0	3.431	0.409
10. Orbital width (cm)	3.8- 5.0	4.285	0.302	3.0- 4.8	3.931	0.544
11. I.O.D. (rostral) (cm)	8.2- 12.0	10.169	1.220	6.2- 11.5	8.538	1.522
12. I.O.D. (middle) (cm)	7.2- 11.0	9.515	1.180	6.5- 11.1	8.831	1.543
13. I.O.D. (caudal) (cm)	9.1- 13.5	11.696	1.365	7.2- 19.0	11.400	3.038
14. Mandibular length (cm)	15.5- 23.0	19.200	2.121	10.5- 21.8	16.115	3.222
15. Mandibular weight (gm)	65.0-225.0	154.231	42.468	38.0-240.0	110.692	57.423
16. Cranial capacity (ml)	100.0-140.0	122.154	19.308	60.0-145.0	95.846	29.274

Table 2: The mean values of the skull indices.

Indices ( mean )	SHEEP	GOAT
cranial index	44.82	47.6
facial index	64.74	73.58
orbital index	71.54	88.40

Table 3: Summary of Simple Correlation Coefficients.

Cranial capacity vs.	sheep	goat
skull length	.3659	.7097 +
skull width	.3211	.7896 +
cranial length	.4570	.8789 ++
cranial width	.1971	.6791
facial length	.1915	.8333 ++
facial width	.3233	.2644
skull weight	.4492	.7129 +
orbital capacity	.0501	.7574 +
orbital height	.3211	.8119 ++
orbital width	.0233	.6856 +
I.O.D. (rostral)	.1745	.8605 ++
I.O.D. (middle)	.1689	.7870 +
I.O.D. (caudal)	.5744	.7401 +
mandibular length	.1543	.7794 +
mandibular width	.1953	.7927 +

+ = 5 %

++ = 1 %

Table (4): The average cranial capacity of the domestic animals and man.

Authors	animal	Average cranial capacity ( ml )
Miller et al., 1964	dog	82 - 92 - 104 ( cc )
Rao 1967	ox	440.0 ± 39.50
Rao 1967	buffalo	527.45 ± 62.12
Sandhu and Dhingra, 1986	camel	587.14 ± 14.89
Saber 1988	sheep	122.154 ± 5.355
Saber 1988	goat	95.846 ± 8.119
Chaturvedi & Harneja, 1962	man	1296 - 1484 ( cc )
Drennan 1927	man	