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THE RELATIONSHIP OF THE BODY-WEIGHT TO THE WEIGHTS OF THE ORGANS :

THE BRAIN

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In continuation of our paper (1949) on the studies of the weight of the heart we present below data in relation to the weight of the brain of normal adults.

A carefully selected group of 46 cases forms the subject of this short note. Selection was based on elimination of cases, where the brain was likely to have been affected by trauma, and pathological processes. The age group has again been between 18 years and 30 years. Only those cases which did not show significant alteration in body-weight by cold storage were included. In this group of 46 cases there were 5 females and 41 males.

As the total number of female bodies in the series is only 5, no significant statistical data can be deduced and hence the actual brain-weight and ratio of brain-weight to body-weight for all 5 cases are set out in table I without any statistical conclusions.

TABLE I
 Females (5)

Age	Body-weight in Kg.	Ratio of brain to body-weight	Brain-weight Gm.
20	37.02	30.6957	1,160
20	40.25	34.69	1,160
22	39.04	24.0152	1,360
22	55.50	50.454	1,100
24	39.04	34.3502	1,030

In the case of male bodies, the results are shown in table II. It was possible to study these in more details and an attempt is made in this note to arrive at statistically significant figures for the subjects under study.

The range of the brain-weight varied from 1,020 gm. to 1,470 gm., the variation being independent of the body-weight. The mean brain-weight in this age group of adult males was 1,218.72 gm. with a standard deviation of 84.824 and a coefficient of variation 6.76. This should give an approximate idea of normal adult brain-weight in Indian male subject.

The weight of the brain was taken after wiping it superficially with a sponge and after removal of the dura mater. The brain, cerebellum, pons and medulla were weighed together.

Jones (1946) gives the normal brain-weights as 1,360 gm. in males and 1,250 gm. in females. These are higher than our male series. Gray (Johnston and Whillis, 1946) states that in the series of 278 males, the maximum brain-weight was 1,840 gm., the minimum brain-weight was 964 gm., and the average brain-weight was 1,380 gm. In the series of 191 females, the same author obtained a maximum brain-weight of 1,585 gm., a minimum brain-weight of 879 gm., and an average brain-weight of 1,250 gm. The age group and statistical mean, S.D. and variation coefficient are not stated. Cunningham (Brash and Jamieson, 1943) gives the average adult brain-weight in males as 1,350 gm. and of females 'rather less'.

TABLE II
Males (41)

Age	Body-weight in Kg.	Ratio of brain to body-weight	Brain-weight Gm.
18	41.76	31.570	1,250
18	69.60	45.360	1,450
18	45.60	35.1025	1,200
18	39.36	29.7501	1,250
20	51.78	37.932	1,290
20	47.04	33.6759	1,320
20	38.40	28.2500	1,270
20	49.32	32.4222	1,350
20	58.56	41.923	1,320
20	40.00	41.802	1,471
20	55.48	35.794	1,020
20	45.12	32.2685	1,230
20	55.68	36.7197	1,260
20	42.72	32.575	1,240
23	49.44	42.6259	1,150
23	51.60	35.5924	1,370
25	56.16	37.908	1,400
25	56.64	41.8157	1,280
25	40.00	32.0585	1,330
25	59.04	41.3277	1,350
25	49.92	36.8542	1,280
25	44.40	38.6755	1,240
25	41.00	33.064	1,350
26	50.88	36.5824	1,250
28	50.88	38.4355	1,260
28	50.88	39.1947	1,250
28	48.00	36.288	1,250
28	53.76	37.0805	1,370
28	37.44	24.0152	1,250
30	45.27	36.879	1,250
30	53.76	36.288	1,400
30	51.12	37.7405	1,280
30	47.60	47.4468	1,140
30	44.76	34.0707	1,240
30	58.08	37.3371	1,470
30	55.48	42.0940	1,250
30	50.88	40.1509	1,230
30	48.48	37.2463	1,230
30	56.64	43.1651	1,240
30	48.48	31.4675	1,440
30	40.00	31.3517	1,360

These authors feel that 'difference is simply related to smaller weight of the body in females. If body-weight is discounted, it appears that the difference in relative weights in the two sexes is insignificant'.

Both these European authors met with higher weights than those in our series. No authentic Indian figures are available so far. Mody (1947) gives average brain-weight of 47.34 oz. (1,420.2 gm.), the minimum brain-weight of 35 oz. (1,050 gm.), and a maximum brain-weight of 57 oz. (1,710 gm.), for males. The same author gives the average brain-weight of 38.29 oz. (1,151.7 gm.), the minimum brain-weight as 30 oz. (900 gm.), and a maximum brain-weight as 48 oz. (1,240 gm.), for females. In our previous paper (1949) on heart-weights we have pointed out difficulties in accepting these figures as representative for the Indian population.

Brain is an organ which increases rapidly in weight in the first year of life and grows speedily till the age of six years, when it makes up 85 per cent of adult weight. The increase

in bulk is due to myelination of tracts. This increase has to run *pari passu* with the size of the cranial cavity. It is so situated that it fills up this closed box completely. As yet, we have no means to assess the relation of brain-weight to intellectual function. Cunningham (Brash and Jamieson, 1943) remarks that though variations in weights met with are considerable, it is extremely unlikely that normal intellectual functions can be carried out by brain weighing less than 1,000 gm. We had no opportunity to assess intellectual functions in our series and none of the brains of our cases weighed so little, nor was any case recorded as mentally defective. In general the powers of memorizing are said to be better developed in Indians but perhaps this does not necessitate so much increase of weight as increase of gyri and sulci to give increased cortical area. In old age the brain-weight diminishes very slowly but Gray (Johnston and Whillis, 1946) states that in any case it is not reduced by more than 28 gm. in all.

Turning to another aspects of consideration and one to which Cunningham has made a passing remark, we have compared ratios of brain-weights to body-weights to do away with vagaries arising out of significant differences in body-weights. The ranges of such ratios are 24.0152 to 47.4468 and the mean of ratios is 36.678 with S.D. of 4.628 and coefficient of variation of 12.45. Only such ratios could be compared with population of other countries. We have not come across similar published records from elsewhere.

We take this opportunity to once again remark that these figures are only a result of planned study of a limited group of males from autopsies in Bombay over a fairly long period and cannot necessarily be representative of a cross section of the population.

Summary

Brain-weights, body-weights, and ratios of brain-weight to body-weight are presented with statistical mean, C.D. and S.D. for brain-weight and the ratios for males of age group 18 to 30 years.

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[The statistical analysis may be subject to revision.—
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