

Original article**Age and Sex Related Changes in Weight of the Whole brain: A Postmortem Study**Fatema K¹, Ara S², Rahman M³, Afroz H⁴**Abstract:**

Objective: Brain weight varies with age and gender. It decreases with age and also in many diseases. This cross-sectional analytical type of study was carried out to establish normal standard in different age groups in weight of the brain and to see the difference between sexes of adult Bangladeshi people. **Materials and Methods:** A total of 70 postmortem human brains of adult age groups ranging from 22-58 years in male and 22-48 years in female were collected from the unclaimed dead bodies during postmortem at the autopsy laboratory in the Department of Forensic Medicine, Dhaka Medical College, Dhaka, from January 2010 to December 2010. The samples were divided into four different age groups i.e. Group A (20-29 years), Group B (30-39 years), Group C (40-49 years) and Group D (50-59 years). The weight of the whole brain was measured and significant differences in weight of the whole brain between different age groups and between male and female were determined. **Results:** In male highest value of weight was 1326.67±41.53 gm in group A and lowest one was 1281.6±40.21 gm in group D. These values of female were 1235.56±48.51 gm in group A and 1197.14±38.61 gm in group C. Significant differences were found in mean weight of the whole brain in male and female in group A (p=0.001), B (p=0.001) and C (p=0.001). The difference of mean weight in different age groups was not statistically significant. **Conclusion:** The weight of the brain is higher in male than in female and it decreases with age.

Keywords: whole brain; weight; age; sex; Bangladeshi people

DOI: <http://dx.doi.org/10.3329/bjms.v13i4.20554>

Bangladesh Journal of Medical Science Vol. 13 No. 04 October '14. Page: 396-400

Introduction:

The brain, the part of central nervous system is regarded as the organ solely concerned with thought, memory, and consciousness, but these are only a few of its complex and varied functions. All information we have concerning the world about us is conveyed centrally to the brain by an elaborate nervous system. The brain is also concerned with all kinds of motor activity, with the regulation of visceral, endocrine and somatic functions, and with the receptive and expressive use of symbols and signs that underlie communication. While the gross features of the human brain are not especially impressive, its versatility, potential capabilities, efficiency, and self programming nature render it unique among all

organs of the human body. The brain consists of the cerebral hemispheres, the brain stem, the diencephalon and the cerebellum¹. It lies within the cranium². Weight of the human brain is about 1400 gm¹. Brain weight varies with age and gender. It decreases with age and also in many diseases. Lower brain weight was reported in schizophrenia³, Parkinson's disease⁴, alcohol dependent person⁵ and brain weight of victim of fatal self-harm was significantly higher than those who died of natural causes⁶. Male brains are about 10% larger than female brains and weigh 11-12% more than that of a woman. This is due to the larger physical stature of

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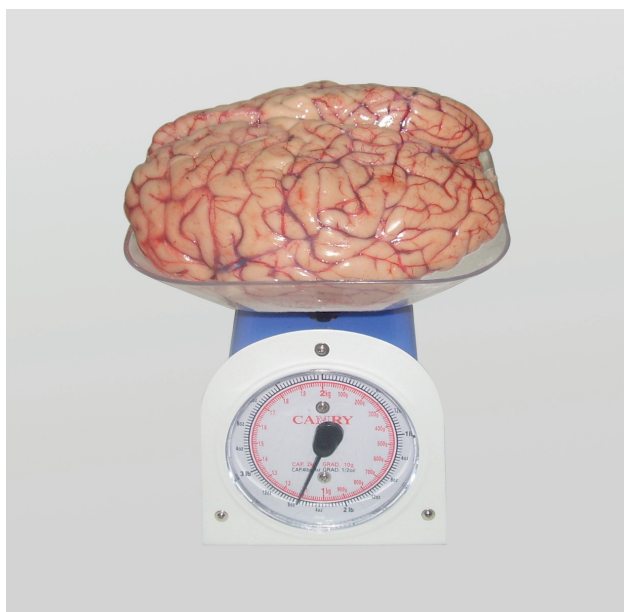


Figure 1: Measurement of weight of the whole human brain.

men. Male's larger muscle mass and larger body size requires more neurons to control them⁷. It is observed by reviewing existing literature that many studies have been done on human brain in foreign countries and showed significant variations were present among different age and sex groups. But there is no existing study on gross anatomy of human brain in our country. In order to find out any changes in weight of whole brain in relation to age and sex in Bangladeshi people we carried out this research. The findings of the present study are expected to help neurologists, radiologists and psychiatrists to adopt appropriate plans for diagnosis and management of diseases of human brain.

Materials and Methods:

The present study was performed on 70 brains of Bangladeshi cadavers of different age groups. The lowest age was 22 years in male and also in female and highest age was 58 years in male and 48 years in female. After completion of all legal formalities and requisite permission from the department of Forensic Medicine, the whole brains were collected from the unclaimed dead bodies during postmortem at the autopsy laboratory in the Department of Forensic Medicine, Dhaka Medical College, Dhaka, from February to December 2010. The whole brains were collected within 24 hours of death. During collection of the samples, appropriate age, sex and the cause of death were noted from the morgue's record book. The samples were brought to the Department of Anatomy, Dhaka Medical College, Dhaka. Soon

after collection, each sample was gently washed with tap water and its surface was dried with blotting paper. Then weight of the whole brain was measured with the help of a weighing machine (Camry Weighing Scale, Camry Electronic Limited, China) in gm (Figure 1). Decomposed brains, injured brains were excluded. The study was approved by the Ethical Review Committee of Dhaka Medical College, Dhaka.

For convenience of description, in relation to age, the collected samples were divided into four groups (according to Magnotta et al.⁸). The samples were divided into four different age groups i.e. Group A (20-29 years), Group B (30-39 years), Group C (40-49 years) and Group D (50-59 years). The data collected from this study were processed to get mean values, standard deviations etc. as applicable. Statistical analyses were done by unpaired student's t test and one-way ANOVA. All the statistical analyses were done by using SPSS 15.0 version.

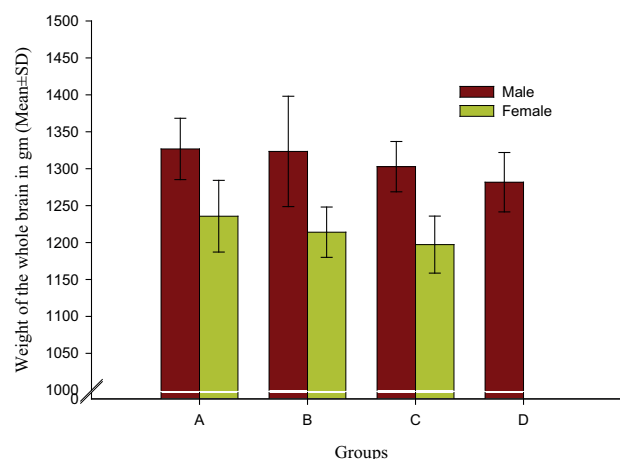


Figure 2: Weight of the whole brain in male and female in different age groups.

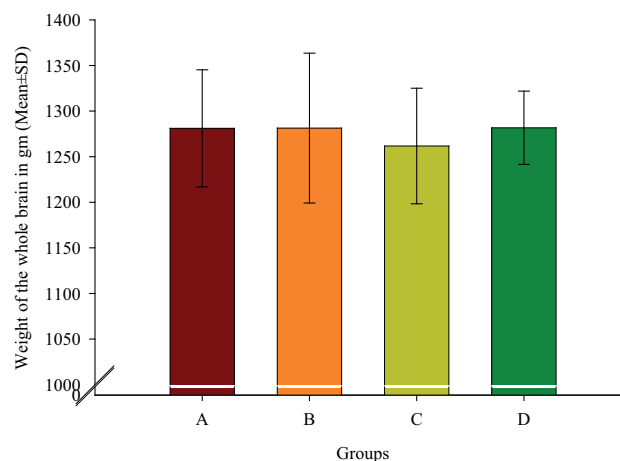


Figure 3: Weight of the whole brain in different age groups.

Results:

In the present study, the mean±SD weight of the whole brain was 1326.67±41.53 gm, 1323.33±74.75 gm, 1302.73±34.09 gm and 1281.6±40.21 gm in group A,B,C and D respectively in male and 1235.56±48.51 gm, 1214.00±34.06 gm and 1197.14±38.61 gm in group A, B and C respectively in female (Table I, Figure 2). Significant differences were found in mean weight of the whole brain in male and female in group A (p=0.001), B (p=0.001) and C (p=0.001) (Table I).

Table I: Weight of the whole brain in male and female in different age groups

Groups (n)	Weight of the whole brain in gm	
A (18)	1281.11 ± 64.16 (1160.00-1370.00)	
B (28)	1284.29 ± 82.17 (1150.00-1440.00)	
C (18)	1261.67 ± 63.36 (1140.00-1340.00)	
D (6)	1281.67 ± 40.21 (1210.00-1330.00)	
		p value
A vs B	>0.50 ^{ns}	
A vs C	>0.50 ^{ns}	
A vs D	>0.50 ^{ns}	
B vs C	>0.50 ^{ns}	
B vs D	>0.50 ^{ns}	
C vs D	>0.50 ^{ns}	

Data was expressed as Mean±SD. Figures in parentheses indicate range. Comparison between sex done by unpaired Student's t test. *** = significant at ≤ 0.001.

The mean±SD weight of the whole brain was 1281.11±64.16 gm, 1284.29±82.17 gm, 1261.67±63.36 gm and 1281.67±40.21 gm in group A, B, C and D respectively. The highest value was found in group A and the lowest one was found in group C (Table II, Figure 3). The difference of mean weight in different age groups was not statistically

significant (Table II).

Table II: Weight of the whole brain in different age groups

Groups Sex (n)	Weight of the whole brain in gm	p value
Group A		
Male (9)	1326.67 ± 41.53 (1260.00-1370.00)	0.001***
Female (9)	1235.56 ± 48.51 (1160.00-1320.00)	
Group B		
Male (18)	1323.33 ± 74.75 (1170.00-1440.00)	0.001***
Female (10)	1214.00 ± 34.06 (1150.00-1250.00)	
Group C		
Male (11)	1302.73 ± 34.09 (1220.00-1340.00)	0.001***
Female (7)	1197.14 ± 38.61 (1140.00-1240.00)	
Group D		
Male (6)	1281.67 ± 40.21 (1210.00-1330.00)	

Data was expressed as Mean±SD. Figures in parentheses indicate range. Comparison between different age group by One-way ANOVA (Post Hoc) test. ns = not significant.

Discussion:

In the present study the mean±SD weight of the whole brain was 1326.67±41.53 gm, 1323.33±74.75 gm, 1302.73±34.09 gm and 1281.6±40.21 gm in group A, B, C and D respectively in male. The mean±SD weight of the whole brain was 1235.56±48.51 gm, 1214.00±34.06 gm and 1197.14±38.61 gm in group A, B and C respectively in female.

Witelson, Kigar and Harvey (1999) studied 35 post-mortem brains (male) of Canadian population with mean age 53 years (30-70 years) with normal neurological and psychiatric status and reported that the mean weight of the brain was 1400 gm⁹. Salib and Tadros (2000) conducted a study on 107 male of mean age 71.7±8 years and 43 female of mean age 72.9±8 years postmortem brains and found that the mean weight of male brain was 1260±79 gm and that of the female brain was 1184±82 gm⁶. Nolte (2002) stated that male brains are slightly larger than female brains and ranging from 1100 gm (or less) to around

1700 gm and average weight is 1400 gm¹⁰. Ribero et al. (2002) studied male and female postmortem brains with an age varying from 20 to 79 years and found that smallest weight was 1086 gm in female and biggest one was 1703.30 gm in male and average weight of the brain was 1395.59 gm in male and 1199.20 gm in female¹¹. Pal, Chowdhury and Ghosh (2003) studied human brains of 6 fresh cadavers and found that mean weight was 1194 ± 28.297 gm¹². Witelson, Beresh and Kigar (2006) carried out a study with postmortem brain of 42 male (mean age 58 ± 12 years) and 48 female (mean age 54 ± 10 years) Caucasian died from non neurological cancer and found that the mean weight of male brain was 1373 ± 102 gm and that of female brain was 1278 ± 103 gm¹³. The weight of the brain of the present study was lower than the findings of Witelson, Kigar and Harvey (1999) and Ribero et al. (2002)^{9,11}. Lowest value of weight in gm of the present study were similar to the findings of Nolte (2002), Ribero et al. (2002) but the highest value of their studies was much higher than values of any age group of the present study^{10,11}. The weight of the brain of the present study was also lower than the findings of Witelson, Beresh and Kigar (2006) study and this dissimilarity may be due to racial variation.

Findings of Pal, Chowdhury and Ghosh (2003) and Salib and Tadros (2000) were lower than the findings of the present study. Pal, Chowdhury and Ghosh (2003) did not mention age and sex of the study population¹². Age of the study population of Salib and Tadros (2000) was ≈ 60 years and mean age was 71.7 ± 8 years in male and 72.9 ± 8 years in female⁶. In the present study, male brains were significantly heavier than female which corresponds with findings of Nolte (2002), Salib and Tadros (2000), Witelson, Beresh and Kigar (2006) and also that of Ribero et al. (2002)^{10,6,13,11}. The findings of the present study showed that the weight of the brain gradually decreased with advancing age and this finding agreed with the findings of Witelson, Beresh and Kigar (2006)¹³.

Conclusion:

It was revealed in the present study that weight of the brain was found to be declined with advancing age and male brain was heavier than female. During the due course time of one year only 70 samples could be collected and female samples were only 26. Because there was no study about brain among Bangladeshi population, comparison could not be done here. Further studies with larger sample size with equal female samples are recommended.

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