

Original article

Variability of adult cerebrum mass of the Saratov-city residents

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Abstract: The research aimed to study the age-gender variability and extreme variants of individual cerebrum mass of Saratov citizens. *Material and methods* – Cerebrum preparations from 191 dead bodies of adults of 21-90 years were used as a material for the research. The whole material was divided into 4 age groups: the 1st group – the 1st adult period and 43 cerebrum preparations (26 male, 17 female); the 2nd group – the 2nd adult period – 82 preparations (66 male, 16 female); the 3rd group – the elderly age period – 34 preparations (16 male, 18 female); the senium age – 32 preparations (16 male and 16 female). The cerebrum was taken apart from the spinal cord at the border with the medulla oblongata and was weighed on analytical balance to within the accuracy of 1.0 g. *Results* – The cerebrum mass of Saratov adult citizens was 1323.69±19.81 g (M±SD) (without including gender and age groups). For men it was 1371.05±20.39 g, for women – 1236.05±32.51 g, i.e. the cerebrum mass of men is more than the women's one in average for 135 g (10.9 %) (P>0.05). The cerebrum mass decrease is registered at the 2nd adult period, which becomes more evident at the senium age. Thus the cerebrum mass at the 1st and the 2nd adult periods differs authentically from its value at the senium age, and at the 1st adult period it differs from its value at the elderly age as well (P<0.05). Considerable individual cerebrum mass variability has aroused the necessity to specify the groups of its extreme variables. An average cerebrum mass is at 47.1 % of Saratov citizens. Small, extremely small, and below average cerebrum mass is registered at 25.2 % of Saratov citizens, and large, above average, and extremely large mass – at 13.6 %. *Conclusion* – Thus the cerebrum mass of Saratov citizens subjected to age-gender variability which lies in the fact that male cerebrum is heavier comparing with female cerebrum, and the cerebrum mass is been decreased from the 2nd adult period. The described cases of a large cerebrum mass at an elderly age, and of small and extremely small cerebrum mass at the 1st and 2nd adult periods, as we think, are connected with the individual variability of subjects' skull forms and volume.

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Introduction

One of the oldest questions of neuro-morphology, physiology and psychiatry is the question of cerebrum mass variation [1-7, etc.]. A human has no other organ like a cerebrum which mass, out of pathological process, would deviate widely from this or that side. The widespread lifetime methods of cerebrum research have caused the necessity to specify the variation range of its mass, i.e. of anatomical rate of people who do not suffer from cerebrum diseases and mental disorder.

The aim of our research is to study the age-gender variability and extreme variables of individual cerebrum mass variability of Saratov citizens

Material and Methods

Cerebrum preparations from 191 dead bodies of adults were used as a material for the research. A wide range (21-90 years) of age representatives (CV=34.4%) was studied, with normal (Tas=1.14, Tes=0.24, P<0.01) and inessential flat-top (Ex=-1.03)

distribution of subjects by age. The whole material was divided into 4 age groups according to the classification which was adopted at the VII All-union Conference of the problems of age morphology, physiology, and biochemistry (Moscow, 1965). The 1st adult period (male: 22-35 years; female: 21-35 years) included 43 cerebrum preparations (26 male, 17 female); the 2nd adult period (male: 36-60 years; female: 36-55 years) – 82 preparations (66 male, 16 female); the elderly age period (male: 61-74 years; female: 56-74 years) – 34 preparations (16 male, 18 female); the senium age period (75-90 years) – 32 preparations (16 male and 16 female). The cerebrum was taken apart from the spinal cord at the border with the medulla oblongata, and was weighed on analytical balance to within the accuracy of 1.0 g.

The data received were analysed by variation-statistical method with the usage of the group of applied programs "Statistica 6.0" soft and Microsoft Excel Windows-XP. For all the parameters there had been determined: the minimum and maximum values (*min-max*), the mean (*M*), error of the mean (*m*), standard deviation (*SD*), the coefficient of variation (*CV*). All

variables were preliminary checked out for the presence of the "jumping-out" variables. The authenticity of differences between the variables' series was determined by the Student's t-test. The differences were considered valid at the 95% of probability ($P < 0.05$). To study an individual variability the $M \pm 0,67SD$ range was taken as an average quantity.

Results

The cerebrum mass of Saratov adult citizens was 1323.69 ± 19.81 g ($M \pm SD$) without including gender and age groups ($n=191$, $min-max=960-1670$, $SD=138.79$, $CV=10.49\%$). For men it was 1371.05 ± 20.39 g ($n=124$, $min-max=1035-1670$, $SD=115.83$, $CV=8.49\%$), for women – 1236.05 ± 32.51 g ($n=67$, $min-max=960-1560$, $SD=10.99$, $CV=10.99\%$), i.e. the cerebrum mass of men is more than the women's one in average for 135 g (10.9 %) ($P > 0,05$). The study of age variability displayed that from the 2nd adult period there the decrease in cerebrum mass has been registered, which becomes strongly evident at the senium age. Thus the cerebrum mass at the 1st and 2nd adult periods differs authentically from its value at the senium age, and at the 1st adult period it differs from its value at the elderly age as well ($P < 0.05$). Considerable individual cerebrum mass variability has caused the necessity to specify the groups of its extreme variables (Table 1, Figure 1).

Average cerebrum mass is met at 47.1 % of Saratov citizens. Small, extremely small, and below average cerebrum mass is registered at 25.2 % of Saratov citizens, and large, above average, and extremely large mass – at 13.6 %.

The group with an extremely small cerebrum mass ($<M - 2SD$) included 9 people, 8 of them were women aged from 36 to 88, and 1 was a man of 78 years. At women the range of cerebrum mass variation was from 960.0 to 1040.0 g. The cerebrum of the lowest mass in the group belonged to a 63-year-old woman. Another woman aged 63 had the heaviest cerebrum (1040.0 g). The cerebrum mass of a man included into the group was 1035.0 g.

The group of 18 people with a small cerebrum mass ($\{(M-2SD) < X < (M-SD)\}$), where there were 13 women aged from 22 to 90, and 5 men aged from 47 to 86. At women the range of cerebrum mass variation was from 1070.0 to 1180.0 g. The lowest cerebrum mass belonged to 4 women aged 22, 35, 74, and 84 years, and, as we can see, the age of the oldest woman was 4 times as much as the age of the youngest one; the largest brain mass belonged to 3 women aged 26, 56, and 90, i.e. from the youthful period to the period of long-livers. At men the range of cerebrum mass variation was from 1150.0 to 1180.0 g. The smallest cerebrum mass belonged to 2 men of 56 and 57 years old. The heaviest cerebrum in the group was at a man of 47 years (1180.0 g).

There were 21 people in the group with cerebrum mass below average ($\{(M-SD) < X < (M-0,67SD)\}$), where there were 12 women aged from 30 to 76 years, and 9 men aged 36 - 87 years. At women the range of cerebrum mass variation was from 1190.0 to 1230.0 g. The cerebrum of the lowest mass in the group belonged to a 70-

year-old woman (1190.0 g). The largest cerebrum mass was at 3 women aged 55, 61, and 76 years old. At men the range of cerebrum mass variation was from 1190.0 to 1230.0 g. The lowest cerebrum mass is registered at a 40-year-old man (1190.0 g), the largest one is at 4 men of 36, 46, 58, and 87 years old.

In the group with an average cerebrum mass ($\{X = (M \pm 0,67SD)\}$) there were 100 people: 25 women aged from 21 to 80 years, and 75 men aged from 23 to 90 years. At women the range of cerebrum mass variation was from 1240.0 to 1360.0 g. The smallest cerebrum is registered at 2 women of 33 and 52 years old, the largest – at a woman of 36 (1360.0 g) years old. At men the range of cerebrum mass variation was from 1240.0 to 1410.0 g. The lowest cerebrum mass in the group was at 3 men aged of 30, 47, and 52 years. And 3 men of 29, 56, and 67 years old had the largest cerebrum mass.

There were 27 people in the group with cerebrum mass above average ($\{(M+0,67SD) < X < (M+SD)\}$): 7 women aged of 21 to 78 years old, and 20 men aged from 23 to 80 years. At women the range of cerebrum mass variation was from 1420.0 to 1460.0 g. The lowest cerebrum was at 2 women of 21 and 78 years old, the heaviest cerebrum in the group was at a 21-year-old woman (1460.0 g). At men the range of cerebrum mass variation was from 1420.0 to 1460.0 g. The lightest cerebrum belonged to a man aged of 42 (1420.0 g) years old, and the heaviest one belonged to 4 men of 34, 40, 46, and 62 years old.

There were 25 people in the group with a large cerebrum mass ($\{X > (M+SD)\}$): 2 women aged of 21 and 50 years old, and 23 men aged from 23 to 70 years. At women the range of cerebrum mass variation was from 1315.0 g (a 51-year-old woman) to 1560.0 g (a 21-year-old woman). At men the range of cerebrum mass variation was from 1470.0 to 1600.0 g. The lowest mass was at 2 men of 30 and 64 years old, and the heaviest cerebrum was also at 2 men of 27 and 37 years old.

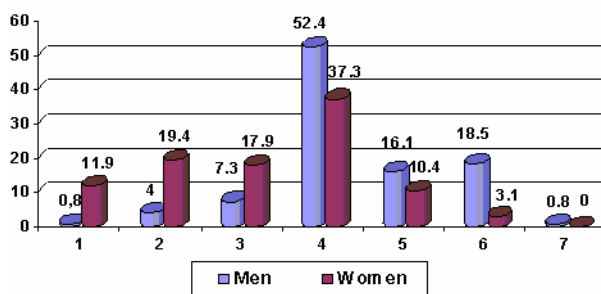


Fig.1. Frequency of Variables Occurrence of Male and Female Cerebrum Mass Variation, %: 1 – $X < (M-2SD)$; 2 – $(M-2SD) < X < (M-SD)$; 3 – $(M-SD) < X < (M-0,67SD)$; 4 – $X = (M \pm 0,67SD)$; 5 – $(M+0,67SD) < X < (M+SD)$; 6 – $X > (M+SD)$; 7 – $X > (M+2SD)$.

Table 1. Variables of Individual Adult Cerebrum Mass Variability of Saratov citizens (n=191)

Variables	Variables of Cerebrum Mass Variability						
	Extremely small $<(M-2SD)$	Small $<(M-SD)$	Below average $<(M-0.67SD)$	Average $= (M \pm 0.67SD)$	Above average $>(M+0.67SD)$	Large $>(M+SD)$	Extremely large $>(M+2SD)$
Value in a group, g	1046.11	1184.90	1230.70	1230.70- 1416.68	1416.68	1462.48	1601.27
Frequency of occurrence, %	4.7%	9.4%	11.1%	47.1%	14.1%	13.1%	0.5%

The group with extremely large cerebrum mass $\{X > (M + 2SD)\}$ includes 1 man of 59 years, whose cerebrum weighed 1670.0 g.

Discussion

The cerebrum mass study experiments have been organized many times. Thus, A.A. Yurgutis (1957) [6] studied the cerebrum mass variability at a young, middle, and elderly age. According to his data the minimum cerebrum mass of an adult is 1020 g, the maximum is 1776 g. As follows from our material, the minimum and maximum mass is lower than the given figures, and is ranging from 960 g to 1670 g. Cerebrum mass at all ages is less at women than at men, and after the age of 50 years the decrease in cerebrum mass of both genders takes place, which is proved by our data as well.

I.N. Bogolepova (1982) [3] studied 205 cerebrum preparations and fixed that the average cerebrum mass is 1404 g. In most cases (73 % of observations), the cerebrum mass was from 1300 to 1600 g. Cerebrum mass fluctuations were essential: in 12 % of observations – from 1600 to 2000 g, in 12 % – from 1000 to 1300 g, in 2.5 % – less than 1000 g, and in 0.5 % – more than 2000 g. The cerebrum mass of Saratov adult citizens was 1323.69 ± 19.81 g ($M \pm SD$) (without including gender and age groups) is a bit lower and equals 1323.69 g. This is probably connected with differences in the value of the extreme variables, these are especially the groups with extremely large cerebrum mass which, according to our material, included cerebrum preparations with the mass more than 1600 g, and the author's material had the mass more than 2000 g.

According G.G. Avtandilov's research (2002) [1], at the age of 20 - 29 years cerebrum mass of men is 1389 g, and of women is 1242 g, at the age of 30-39 years it is 1387 and 1271 g; at the age of 40-49 years – 1360 and 1240 g; at the age of 50-59 years – 1338 and 1253 g; at the age of 60-69 years – 1306 and 1209, and, finally, at the age over 70 years the cerebrum mass of men and women is 1266 and 1150 g respectively. He accurately retraced the gender differences in cerebrum mass value displayed in each age group, which coincided with the results of our work.

According to the World Health Organization (WHO), the cerebrum mass of a "conventional person" averages 1400 g at men and 1200 g at women. According to the Big medical encyclopedia, the cerebrum mass of men and women equals 1375 and 1275 g respectively. The average cerebrum mass of men – Saratov citizens – is 28.95 g less, and that of women is 36.05 g more, compared with the data given by WHO. At the same time, the cerebrum mass of Saratov men coincides with its value given in the Big medical encyclopedia, and as for Saratov women, it is 36.05 g less.

Conclusion

Thus it can be said that the cerebrum mass of the Saratov citizens undergoes age-gender variability which lies in the fact that male cerebrum is heavier in comparison with female cerebrum, and that the cerebrum mass decreases from the 2nd adult period. The described cases of large cerebrum mass at an elderly age, and, vice versa, of small and extremely small cerebrum mass at the 1st and 2nd adult periods, as we think, are connected with the individual variability of subjects' skull form and volume.

Conflict of interest: none declared.

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