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Research Article

# Gender and Age-Related Changes in The Temporal Lobe Among Adult Sudanese

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## Abstract

**Background:** The temporal lobe is the second-largest lobe, houses several critical brain structures including the hippocampus and the amygdala, including areas with auditory, olfactory, vestibular, visual, and linguistic functions. This study aimed to determine the volume and volume fraction of left temporal lobe in healthy adult Sudanese and to show the age and gender-related structural changes in the temporal lobe using a stereological method.

**Material and Methods:** Randomly selected 35 healthy young Sudanese (17 males and 18 females) aged between (20-45) with normal MRI brain was conducted in this study the MR images'' were analyzed using ImageJ software.

**Results:** The mean volume of the left cerebral hemisphere was 21.41± 1.7cm3 and 19.85±1.6 cm3for males and females respectively. The mean volume of the left temporal lobe was 5.76 ±0.72 cm3and 5.6 ± 0.56 cm3 for males and females respectively. Males have significantly larger temporal lobe volume than females. There is no significant difference in the volume faction between both genders. There was no correlation between left temporal lobe volume and age or BMI.

**Conclusion:** The stereological measurements of the temporal lobe and understanding its structural changes are important for many clinical aspects. Further studies with a large sample and narrow age group are recommended.

**Keywords:** The Temporal Lobe; ImageJ; Gender; Age

## Introduction

The brain has developed and changed through time, so some areas of the brain are older than others. The cortex or neocortex represents recent brain development in the human While there are separable regions and parts of the brain, such as the two hemispheres and the four major lobes, nonetheless, the brain is highly interconnected with an extensive fiber pathway system that connects the hemispheres, the lobes, and provides circuits to subcortical regions [1].

The temporal lobe the second-largest lobe, after the larger frontal lobe, accounts for 22% of the total neocortical volume which is the largest in man, accommodating 17% of the cerebral cortex [2], The temporal lobe of the brain is often referred to as the neocortex. It forms the cerebral cortex in conjunction with the occipital lobe, the parietal lobe, and the frontal lobe. It is located mainly in the middle cranial fossa, a space located close to the skull base. It is anterior to the occipital lobe and posterior to the frontal lobe. It is found inferior to the lateral fissure, also known as the Sylvian fissure or the lateral sulcus. The temporal lobe subdivides further into the superior temporal lobe, the middle temporal lobe, and the inferior temporal lobe. It houses several critical brain structures including the hippocampus and the amygdala, including areas with auditory, olfactory, vestibular, visual, and linguistic functions [3,4].

The primary functions of the temporal lobe are to process sensory information and derive it into meaningful memories, language, and emotions. The temporal lobe is responsible primarily for declarative memory, Wernicke aphasia is one clinical presentation of damage to the temporal lobe. It is seen often in patients who have suffered an ischemic stroke to the temporal lobe [3,6,7].

Aging represents the accumulation of changes in a human being over time, especially in the brain. Aging is among the greatest known risk factors for most human diseases, Regarding aging and temporal lobe imaging and postmortem studies provide converging evidence that beginning in adolescence, gray matter volume declines linearly until old age, while cerebrospinal fluid volumes are stable in adulthood age 20-50 years. This study indicated that there is Age-related linear loss in gray matter volume of temporal lobes. This study also suggested that white matter volume increased until age 47 years for the temporal lobes and then declined [6].

This study showed Increasing age was associated with [1] decreasing volumes of the cerebral hemispheres (0.23% per year), the temporal lobes (0.28% per year), and the amygdala-hippocampal complex (0.30% per year) this study also revealed many elderly subjects did not sustain cortical atrophy or lateral ventricular enlargement, which indicates that such changes are not inevitable consequences of advancing age [7].

Many studies proved the contributions of age to variance in both medial and lateral temporal lobe volumes.

Another study showed that the temporal lobe subregions that showed the strongest unique age-related reductions were the hippocampus, fusiform gyrus, and parahippocampus. These results suggest age-related reductions in temporal lobe subvolumes [8].

Many studies were proved that structural changes in the human brain may be affected by gender.

The gender-related effect is noticeable in all brain areas but is most significant in the superior temporal gyrus, Heschl's gyrus, the adjacent white matter regions in the temporal stem, and the knee of the optic radiation [9].

One study showed significantly greater cortical thickness in women compared to men, after correcting for individual differences in brain size, while no significant regional thickness increases were observed in males. Although a small cortical region in the lateral temporal lobes showed greater thickness in males [10].

Another study revealed sex-specific maturational changes in the volumes of medial temporal structures, with the left amygdala increasing significantly only in males and with the right hippocampus increasing significantly only in females. And also showed that Right-greater-than-left laterality effects were found for the temporal lobe, superior temporal gyrus, amygdala, and hippocampal volumes [11].

Another study suggested that the effects were similar to those in the temporal lobe, with men having larger volumes than women and right volume being greater than left and also suggesting that the effects of aging of temporal lobes are more notable in men than women [12].

This study aims to determine the gender and age structural changes in the temporal lobe among the young adult Sudanese population from magnetic resonance (MR) images using ImageJ software.

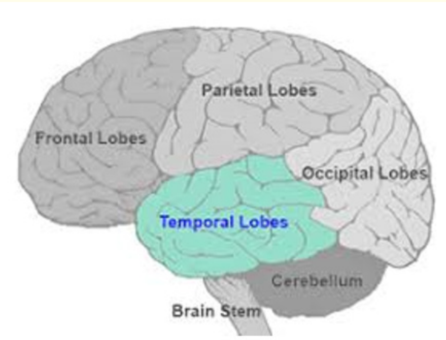
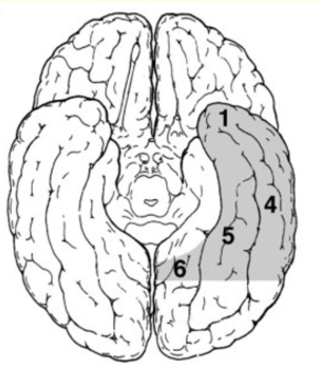



**Figure 1:** Represents the lateral view of the cerebral hemisphere showing the 4 lobes of the cerebral hemisphere, cerebellum, and brainstem.



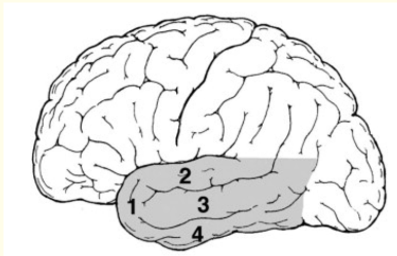



**Figure 2:** Represents the temporal lobe from a lateral and inferior view showing the different functional areas of the temporal lobe.

## Methodology and Ethical Considerations

Facility-based Descriptive Cross-Sectional studies were implemented. including Healthy young adults Sudanese from different Sudanese tribes. Their age was ranging between20 and 45 years. A 35 Magnetic Resonance (MR) images of 35 healthy young adult Sudanese (17 males and 18 females) aged between (20-45). Systematic random sampling, by using ImageJ program since a large number of sections.

For the cerebral hemisphere, every 5$^{th}$ section was selected and for the temporal lobe, every 3rd section was selected, focusing on the Left cerebral hemisphere and left temporal lobe.

## Data management and analysis

Data were obtained from MRI scans Structural MRI was done in radiology department, Doctor's Clinic. then was analyzed using ImageJ the data was entered in the statistical package for social sciences (SPSS 23). the statistical analysis perform was firstly a descriptive statistic to summarize the data graphically (including the frequency tables). Association between variables was performed through chi-square tests. All tests were considered statistical significance with p-value less than 0.05.

## Ethical consideration

Ethical Approval was taken from the National University research committee.

Permission was taken from each participant.

## Results

The sociodemographic characteristics

The total number of samples was 35, 17(48%) were male and 18 (52%) were females (Table 1).

| Region of interest | Male | Females |
|---|---|---|
| **The** volume of the Left Cerebral hemisphere | 21.41 ± 1.7 | 19.85 ± 1.6 |
| Volume of the left temporal lobe | 5.76 ± 0.72 | 5.60 ± 0.56 |
| Volume fraction of the left temporal lobe | 0.26 ± 0.02 | 0.27 ± 0.01 |

**Table 1:** Shows the comparison between genders in the regions of interest.

The mean age of the sample was 35.5 ± 5.2

The mean body mass index (BMI) of the sample was 24.8 ± 4.8 (normal).

The average BMI for males was 23 and for females was 26.54.

There is no significant difference in the volume of the left cerebral hemisphere between males and females ($P > 0.05$).

Mean volume of the left temporal lobe is larger in males than in females ($P < 0.05$).

There is no significant difference in the volume fraction of the left temporal lobe between males and females ($P > 0.05$)

There is no significant correlation between the mean volume of the left temporal lobe and age.

There is no significant correlation between the mean volume of the temporal lobe and body mass index (BMI)

## Discussion

MRI has boosted the research on the structure and function of the human brain. MRI has become the main modality for clinical neuroimaging.

This study determined the relationship between the volume of the left temporal lobe and age/body mass index

This study showed that there is no correlation between the mean volume of temporal and age, this result is opposite to finding in the study done by [8] that suggested white matter volume increased until age 47 years for the temporal lobes and then declined and also unlike study done by [10] That stated a significant age-related reduction in the volume of temporal lobe subvolume structures that might be because this study was done among young population whom brain volume is stable.

The present study reported that there is no significant correlation between the mean volume of the left temporal lobe and body mass index (BMI). According to this finding, volume of the left temporal lobe is an independent variable of BMI.

This study also showed that there is a statistically significant difference in the mean volume of the temporal lobe between males and females that consisted with many studies in the literature [10-12] that shadowed that male having a greater temporal lobe volume than females and a significant increase in the volume of the temporal sub volume structures in male mare than female.

## Conclusion

This study determined the mean volume of left cerebral hemisphere, left temporal lobe and volume fraction of the left temporal lobe from T1 magnetic resonance (MR) by using ImageJ software. There is a statistically significant difference in volume of the left temporal lobe between males and females. more studies regarding the temporal lobe using more advanced software to measure the temporal lobe and sub volume structures with larger sample size is required.

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