

Epilepsy linked to brain volume and thickness differences

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Generalized 3 Hz spike and wave discharges in a child with childhood absence epilepsy. Credit: Wikipedia.

Epilepsy is associated with thickness and volume differences in the grey matter of several brain regions, according to new research led by UCL and the Keck School of Medicine of USC.

The largest-ever neuroimaging study of people with [epilepsy](#), published today in *Brain*, shows that epilepsy involves more widespread physical differences than previously assumed, even in types of epilepsy that are typically considered to be more benign if seizures are under control.

The brain abnormalities the researchers identified were subtle, and have not yet been implicated in any loss of function.

"We found differences in brain matter even in common epilepsies that are often considered to be comparatively benign. While we haven't yet assessed the impact of these differences, our findings suggest there's more to epilepsy than we realise, and now we need to do more research to understand the causes of these differences," said the study's lead author, Professor Sanjay Sisodiya (UCL Institute of Neurology & Epilepsy Society).

Epilepsy is a neurological disorder that affects 0.6-1.5% of the global population, comprising many different syndromes and conditions, and defined by a tendency for seizures.

The study was conducted by the global ENIGMA-Epilepsy consortium, part of ENIGMA which is headquartered at the Keck School of Medicine of USC, and pooled data from 24 research centres across Europe, North and South America, Asia and Australia. Structural brain measures were extracted from MRI brain scans of 2,149 people with epilepsy, and compared with 1,727 healthy controls. The epilepsy group was analysed together for common patterns, and divided into four subgroups to identify differences.

The team found reduced grey matter thickness in parts of the brain's outer layer (cortex) and reduced volume in subcortical [brain regions](#) in all epilepsy groups when compared to the control group. Reduced volume and thickness were associated with longer duration of epilepsy. Notably, people with epilepsy exhibited lower volume in the right thalamus - a region which relays sensory and motor signals, and has previously only been associated with certain epilepsies - and reduced thickness in the motor cortex, which controls the body's movement.

These patterns were even present among people with idiopathic generalised epilepsies, a type of epilepsy characterised by a lack of any noticeable changes in the brain, such that typically an experienced neuroradiologist would not be able to see anything unusual in their brain scans.

"Some of the differences we found were so subtle they could only be detected due to the large sample size that provided us with very robust, detailed data," said the study's first author, Dr Christopher Whelan (Mark and Mary Stevens Neuroimaging and Informatics Institute at the Keck School of Medicine of USC & Royal College of Surgeons in Ireland).

The researchers also identified differences between the subgroups, which they say must reflect differences in underlying biology, as suggested by recent genetic studies.

"We have identified a common neuroanatomical signature of epilepsy, across multiple epilepsy types. We found that structural changes are present in multiple brain regions, which informs our understanding of epilepsy as a network disorder," Dr Whelan said.

The authors say their findings need to be followed up by longitudinal and genetic studies which could clarify the cause of the structural

differences.

"From our study, we cannot tell whether the structural brain [differences](#) are caused by seizures, or perhaps an initial insult to the brain, or other consequences of seizures - nor do we know how this might progress over time. But by identifying these patterns, we are developing a neuroanatomical map showing which [brain](#) measures are key for further studies that could improve our understanding and treatment of the epilepsies," said Professor Sisodiya.

More information: Christopher D Whelan et al, Structural brain abnormalities in the common epilepsies assessed in a worldwide ENIGMA study, *Brain* (2017). [DOI: 10.1093/brain/awx341](https://doi.org/10.1093/brain/awx341)

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