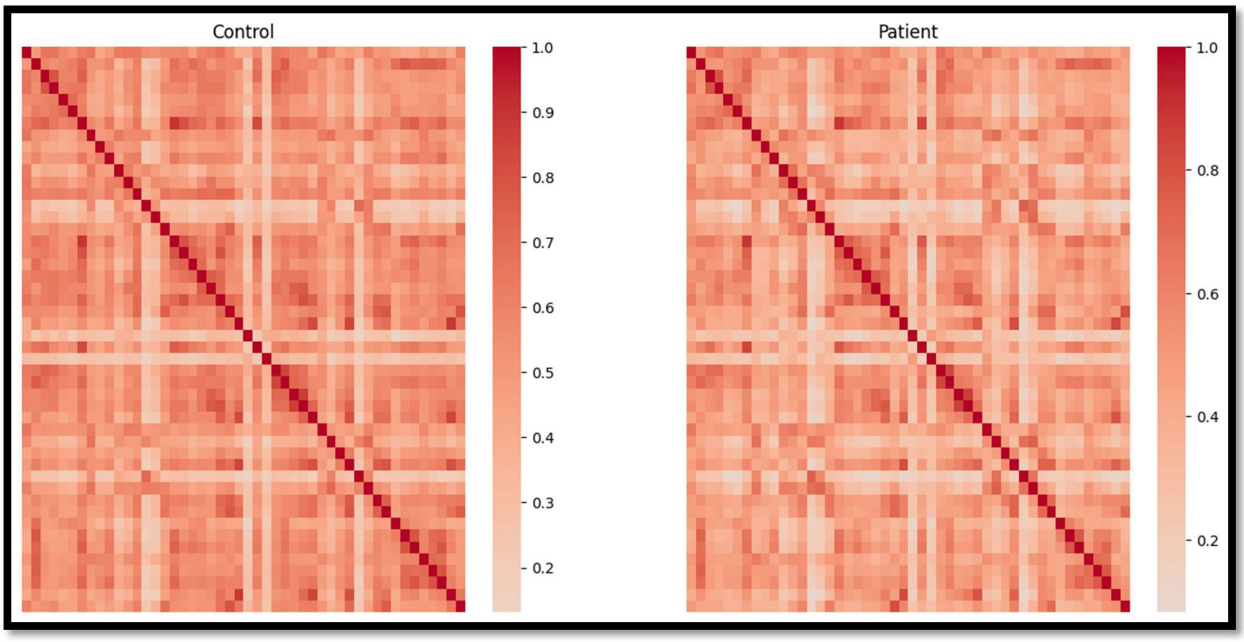
## Brain Network Analysis: Schizophrenia vs. Control

This report presents a comparative analysis of brain networks in schizophrenia patients versus healthy controls.

### *Interpretation of Correlation Matrices*




In the image above functional connectivity matrices for both healthy controls (left) and schizophrenia patients (right) is shown. Each matrix that we can see is the correlation between time-series activity of different brain regions, darker colors indicating stronger correlations between regions.
Observations:

- The control group shows stronger correlations, while schizophrenia patients exhibit weaker connectivity, indicating network disruptions.
- The control group's correlation matrix exhibits more structured patterns, possibly reflecting better-defined functional networks in healthy brains.
- The patient group has more diffuse and lower correlation values, indicating disrupted or less synchronized communication between brain regions.

**Schizophrenia patients show weaker and less organized brain connectivity, which may explain cognitive impairments**

## *Disrupted Brain Network Connectivity in Schizophrenia*

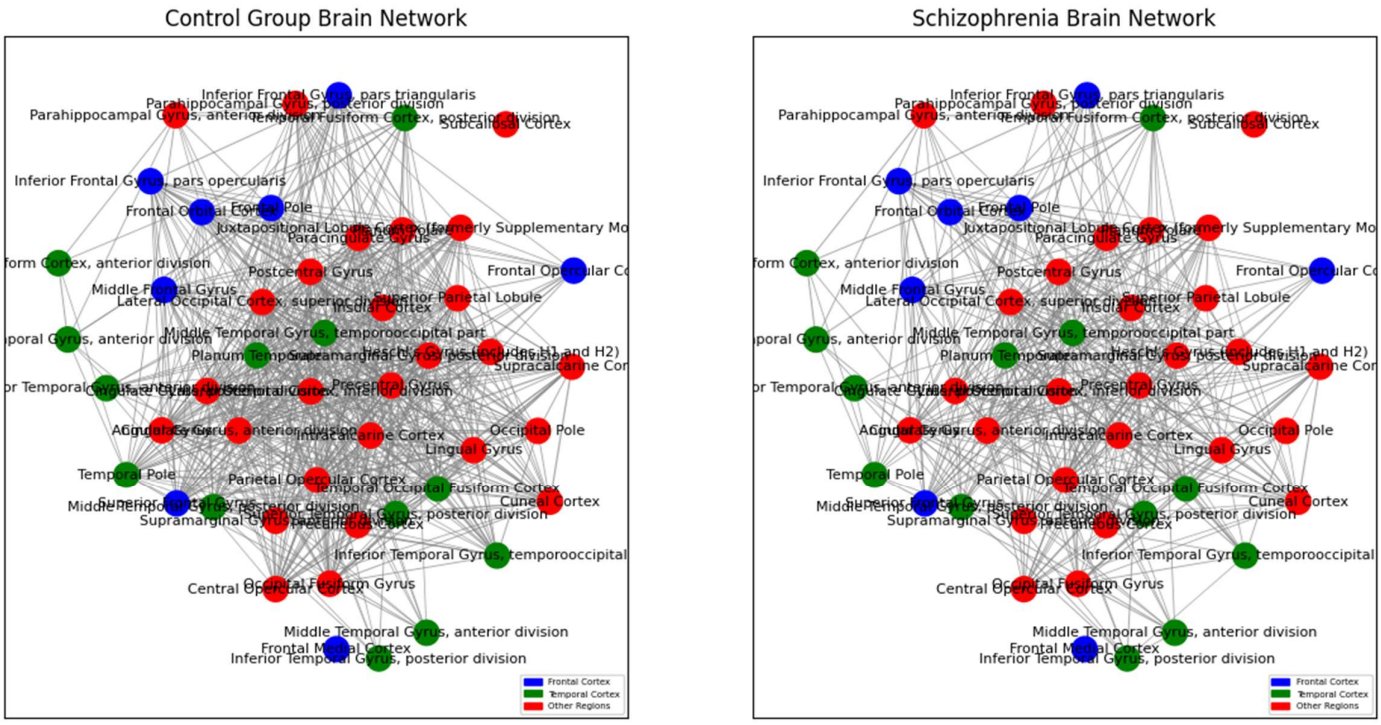



Image above represents functional brain networks for the control and schizophrenia groups. Each node represents a brain region, and connections (edges) indicate the strength of functional correlations between them. Comparing these networks helps reveal how schizophrenia affects brain connectivity.
Observations:

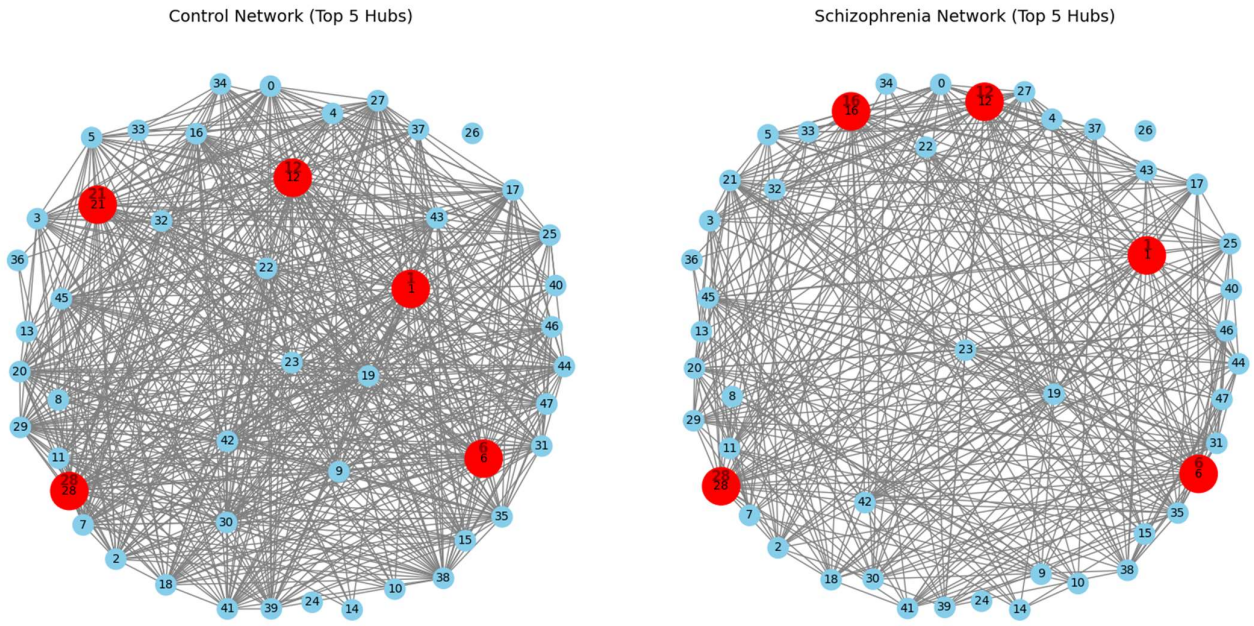
- The schizophrenia group shows fewer and weaker connections between brain regions, indicating disrupted communication.
- While the control group has a well-organized network, the schizophrenia group's network appears less structured and fragmented.
- Changes are especially noticeable in the frontal and temporal cortices, which are critical for cognitive functions like memory, decision-making, and social behaviour.

## *Network Metrics Comparison*

To better understand differences in brain network organization, I calculated various graph metrices.
Observations:

- The schizophrenia group has lower **density (0.3475 vs. 0.5550)** and **average degree (16.33 vs. 26.08)**, indicating fewer overall connections in the brain network.
- The **clustering coefficient** is lower in schizophrenia (0.6551 vs. 0.7796), suggesting disrupted local connectivity and reduced communication between neighbouring brain regions.
- The schizophrenia network has a higher **average betweenness (0.0150 vs. 0.0086)**, indicating that fewer nodes play a more critical role in information flow, which may lead to inefficiencies in signal transmission.

## *Network Centrality and Global Efficiency Analysis*




Centrality measures and global efficiency provide insights into how well the brain network is organized for communication and information flow. Disruptions in these properties can indicate functional impairments in schizophrenia.

Observations:

- The control network has well-distributed and stronger hubs, while schizophrenia shows fewer and less connected hubs. This suggests that information flow is disturbed in schizophrenia.
- Some high-centrality nodes in the control group lose importance in schizophrenia, suggesting reorganization in functional brain networks.
- Global Efficiency Reduction:
    - Global Efficiency Control: 0.7308
    - Global Efficiency Schizophrenia: 0.6127
    - Interpretation: Patients with schizophrenia have reduced global efficiency, meaning their brain networks facilitate slower and less efficient communication compared to healthy controls.

**Overall, my analysis shows that brain networks in schizophrenia patients are less connected and less efficient compared to healthy individuals. The patient network has fewer connections, lower clustering, and fewer highly connected hubs, meaning the brain regions communicate less effectively. Some nodes play a bigger role in connecting the network, but this suggests the brain is trying to compensate in an inefficient way. The lower global efficiency confirms that information transfer is slower, which could explain some cognitive difficulties in schizophrenia. Overall, these results suggest that schizophrenia affects brain organization, making communication between brain regions weaker and less efficient.**