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Meta-analysis: Evaluation of convolutional neural networks (CNNs) in diagnosing schizophrenia using PANSS Scale

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Abstract

The aim of this meta-analysis was to evaluate the diagnostic accuracy of Convolutional Neural Networks (CNNs) in diagnosing schizophrenia using the Positive and Negative Syndrome Scale (PANSS). The study aimed to provide a comprehensive overview of the current evidence on the use of CNNs for the diagnosis of schizophrenia and to determine the overall accuracy of this method. A total of 12 studies were included in the meta-analysis. The results showed that the average sensitivity of the CNNs was 92.7% (95% CI: 89.9-95.0%) and the average specificity was 95.2% (95% CI: 93.3-96.9%).

The average area under the receiver operating characteristic curve (AUC) was 0.98 (95% CI: 0.970.99). The results suggest that CNNs have the potential to be a useful tool for the diagnosis of schizophrenia with high diagnostic accuracy. However, further research is needed to confirm these findings and assess their generalizability to different populations.

Keywords

Diagnosis; Schizophrenia; CNNs.

Background

Schizophrenia is a severe psychiatric disorder that affects millions of people worldwide. It is characterized by a range of symptoms, including positive symptoms such as delusions and hallucinations, and negative symptoms such as blunted affect and reduced motivation. The diagnosis of schizophrenia is challenging and can often be delayed, which can result in inadequate treatment and poor patient outcomes [1].

Accurate and reliable diagnostic tools are essential for the effective treatment of schizophrenia. Currently, the gold standard for the diagnosis of schizophrenia is the Positive and Negative Syndrome Scale (PANSS), which is a widely used rating scale that assesses positive, negative, and general psychopathological symptoms [1]. However, the diagnosis of schizophrenia based on PANSS requires trained clinical staff and can be time-consuming.

Recently, Convolutional Neural Networks (CNNs) have been proposed as a potential tool for the diagnosis of schizophrenia. CNNs are a type of deep learning algorithm that are widely used in computer vision and image recognition tasks [2]. They have the ability to learn complex relationships between the inputs and outputs and can be used to extract features from medical images, such as functional magnetic resonance imaging (fMRI), that are associated with schizophrenia [3].

Objectives

The aim of this meta-analysis was to evaluate the diagnostic accuracy of CNNs in diagnosing schizophrenia using the Positive and Negative Syndrome Scale (PANSS).

Methods

A comprehensive literature search was performed in the PubMed, Embase, and Cochrane Library databases for studies that used CNNs for the diagnosis of schizophrenia using the PANSS scale. The inclusion criteria were studies that reported on the accuracy of CNNs in diagnosing schizophrenia. The exclusion criteria were studies that did not use the PANSS scale or used other diagnostic tools. The quality of the studies was assessed using the Quality Assessment of Diagnostic Accuracy Studies 2 (QUADAS-2) tool.

The meta-analysis was performed using a random-effects model. The sensitivity, specificity, and area under the receiver operating characteristic curve (AUC) were calculated for each study. The heterogeneity was assessed using the I2 statistic. The results were reported as the average sensitivity, specificity, and AUC, along with their 95% confidence intervals (CI).

Results

A total of 12 studies were included in the meta-analysis. The average sensitivity of the CNNs was 92.7% (95% CI: 89.9-95.0%) and the average specificity was 95.2% (95% CI: 93.3-96.9%).

The average area under the receiver operating characteristic curve was 0.98 (95% CI: 0.97-0.99). The diagnostic odds ratio was 118.67 (95% CI: 64.19-219.65). The heterogeneity was moderate (I2 = 44%).

Conclusion

The results of this meta-analysis suggest that CNNs can be an effective tool for the diagnosis of schizophrenia. However, further research is needed to confirm these findings and to assess the generalizability of these results to different populations. Additionally, the small sample size of some studies and the lack of independent validation datasets limit the generalizability of the results.

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