Innovation and Research Week

שבוע חדשנות ומחקר

Revolutionizing Diabetic Retinopathy Screening: Unleashing the Power of a Multi-Modal Semi-Supervised Deep Neural Network for Early Risk Stratifications

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Background

Diabetic Retinopathy (DR) is a major cause of preventable blindness among working-age individuals worldwide. Despite the well-known risk factors associated with DR, current screening guidelines do not adequately consider these factors, resulting in a general recommendation of annual check-ups for diabetic patients. In this study, we explore the potential of precise individual risk stratification based on historical clinical data to improve the prediction of sight-threatening diabetic retinopathy (STDR).

Aims

The primary aim of this study is to investigate the effectiveness of precise individual risk stratification based on historical clinical data in predicting the risk of sight-threatening diabetic retinopathy (STDR). By analyzing comprehensive historical clinical information, we aim to determine whether this approach can provide improved accuracy and reliability in identifying individuals at a higher risk of developing STDR.

Methods

Using a retrospective cross-sectional design, we included diabetic patients who underwent Color Fundus Retinal imaging at the southern district of Clalit Health Services between 2009 and 2015. We mined relevant historical data for each patient, including blood test results, drug prescriptions and usage, diagnoses, demographics, and vital signs. Retinal images were analyzed, classified, and quantified semi-automatically using a well-trained machine learning algorithm. Anomaly detection techniques were applied by a retinal specialist to the automatically labeled images.

Results

The uniqueness of our study lies in the utilization of time series data for diabetic retinopathy detection. We developed three distinct models: the tabular model achieved an AUC of 0.84, the image-only model achieved an AUC of 0.93, and the multi-modal model, incorporating both clinical data and retinal images over time, showcased remarkable performance with an AUC of 0.97. Notably, the multi-modal model outperformed both individual models, highlighting the added value of incorporating temporal information for improved predictive accuracy in diabetic retinopathy detection. These findings underscore the significance of considering the temporal aspect in risk assessment and demonstrate the superiority of the multi-modal approach in leveraging time series data for early detection of diabetic retinopathy.

Discussion and Conclusions

Our study uniquely utilized time series data for detecting diabetic retinopathy. We developed three models: tabular (AUC 0.84), image-only (AUC 0.93), and multi-modal (AUC 0.97). The multi-modal model, combining clinical data and retinal images over time, outperformed both individual models, highlighting the value of temporal information in accurate prediction. These findings emphasize the importance of considering the temporal aspect in risk assessment and demonstrate the superiority of the multi-modal approach in leveraging time series data for early detection of diabetic retinopathy.