

TITLE: Predictive modeling of cardiovascular risk factors using OCT and Fundus Images with deep learning techniques.

PURPOSE: The study aims to develop and test predictive models using fundus and Optical Coherence Tomography (OCT) images to detect retinal structural patterns linked to cardiovascular risk factor and events, specifically arterial hypertension (AHT), type II diabetes mellitus (T2D) and dyslipidemia.

SETTING/VENUE: Ophthalmology Service of Germans Trias i Pujol University Hospital, Badalona, Catalonia, Spain.

METHODS: The study included patients over 18 years old registered in the hospital information system, regardless of cardiovascular disease history. Imaging data comprised macula-centered and optic nerve-centered OCT images, as well as 45° or greater fundus images, collected between January 2016 and May 2024. A total of 30,773 OCT images were extracted, including 3,837 OCTs from health subjects, which were used as control group across three predictive models. Cohorts included 6,321 OCTs from patients with AHT, 3,479 from those with T2D and 6,824 from patients with dyslipidemia, with some images overlapping across cohorts due to comorbidities. Three predictive models were developed, each targeting one cardiovascular risk factor. For each cohort, two reference architectures, SwinTransformerV2 and RETFound, were trained and tested to compare their ability to capture structural retinal patterns associated with the studied risk factors. Predictive performance of the models was assessed using the area under the receiver operating characteristic curve (AUC).

RESULTS: The model performance varied across cardiovascular risk factors and architectures. For AHT, the SwinTransformerV2 model achieved an AUC of 0.875, whereas RETFound reached 0.895. In the T2D cohort, SwinTransformerV2 yielded an AUC of 0.884, compared to 0.906 for RETFound. For dyslipidemia, the SwinTransformerV2 model obtained an AUC of 0.847, whereas RETFound achieved 0.869. Across all risk factors, RETFound consistently outperformed SwinTransformerV2, demonstrating superior ability to identify structural retinal patterns associated with the studied cardiovascular risk factors.

CONCLUSION: These findings confirm that the development of deep learning models can effectively identify retinal structural patterns associated with major cardiovascular risk factors, fulfilling the study objective. RETFound showed superior discriminative performance across all models, demonstrating its greater ability to capture disease-related retinal features. Overall, the results support the use of retina imaging based in AI as a reliable tool for cardiovascular risk assessment and as a potential aid for early patient stratification in clinical settings.